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ABSTRACT

This volume contains 45 conference papers and case studies presented by telecommunications professionals covering technical, business, user, and policy aspects of telecommunications in the Pacific hemisphere. Actual projects in existence or being planned, viewpoints, and guidelines for future development are discussed, with the proceedings organized by days to reflect the conference format. Following an introductory paper on communications and developing countries, three major sections cover current, in-progress, and future developments in telecommunications. The first section emphasizes basic telecommunications systems, beginning with a case study of the Chilean Telecommunications system. Individual papers then address communications in Taiwan, the Fiji Islands, Alaska, and the Philippines, as well as related general issues. A case study of the Alaskan telecommunications system is followed by a section focusing on developing telecommunications services and emerging technology, including packet and circuit switching technology, the voice store and forward system, and undersea systems. The final case study of the Australian National Satellite System is followed by papers addressing future services and projected communications developments, both generally and specifically, in the Pacific Islands, Japan, and New Zealand. Individual abstracts, reference lists, tables, and figures are included with many papers.
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PTC '82

PACIFIC TELECOMMUNICATIONS CONFERENCE

Papers and Proceedings of a Conference
held January 17-20, 1982
at the
Ilikai Hotel, Honolulu, Hawaii

Edited by
DAN J. WEDEMEYER

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Foreword

PTC '82 is, in many ways, unique from each of the three previous PTC conferences. The first thing that you will notice is that the '82 proceedings volume is smaller than in earlier years. This symbolizes a shift in conference format from an emphasis on "authors presenting papers to audiences," to an emphasis on authors and participants interacting in panel and round-table discussions.

As you will experience, each morning the conference opens with keynote addresses followed by case studies and individual paper presentations. This volume contains all of the prepared material for the morning activities. Each afternoon, authors and selected participants assemble for three topical panel discussions. Finally, each day ends with a large, single round-table discussion drawing from the morning material and the panel interactions. While it is obvious that these discussions cannot be contained in this volume, space is provided for detailed notetaking. These proceedings, then, have been organized to support the interactive nature of the conference.

Because the quality of the panel and round-table discussions depend upon it, we have taken special care in requesting and accepting this year's papers. As such, the contents of this volume reflect quality-controlled, "state-of-the-art" thinking from noted telecommunication professionals from around the Pacific Hemisphere. It is becoming a tradition that each year the foremost thinkers, researchers, government officials and corporate officials use this forum provided by the Pacific Telecommunications Council to present their latest thoughts on the problems and possibilities of telecommunication.

The contents of this volume parallels the chronology and format of the conference. Prepared materials and space for taking notes on the opening keynote addresses appear before the first day's material. The manuscripts of the first day are presented before the materials of the second day. In turn, the second day's materials are presented in full before the last day's materials.

The Pacific Telecommunications Conference has grown significantly over the past four years. We hope that you experience the quality and scope of this growth in these proceedings. We have made every effort to provide the PTC '82 participant with an opportunity to be exposed to, and interact with, notable persons in the diverse and dynamic arena of Pacific telecommunication. The materials presented here set the stage for PTC '82. As editor, I hope that you find the papers and discussions both interesting and useful in your individual endeavors.

Aloha,

Dan J. Wedemeyer
Editor, PTC '82

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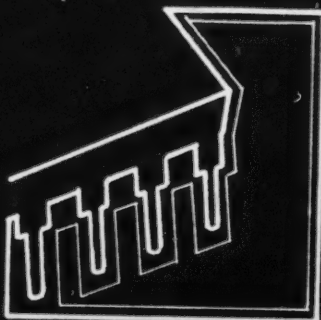
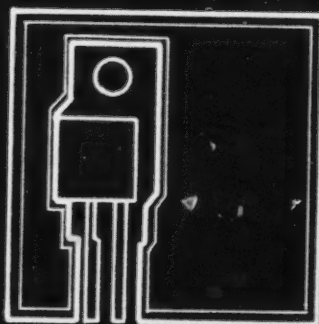
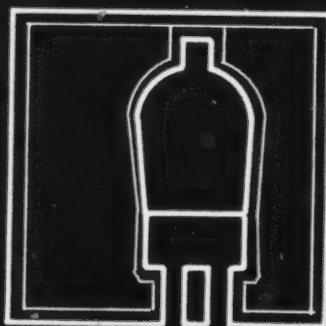
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Sunday, January 17:
Opening Plenary
Session



COMMUNICATIONS AND DEVELOPING COUNTRIES IN THE PACIFIC

Sir Thomas Davis KBE
Prime Minister, Cook Islands

Without communications development of developing countries cannot proceed at an acceptable rate. In the Pacific where communities tend to be widespread communications is regarded more as a Government revenue maker than a developmental tool. Modern communications are not costly. Loss of revenue in liberalising communications is far outweighed by national development gains.

A constant common denominator of successful nations in the past and the present has been communications. Genghis Khan who ruled from the Baltic to the China Sea assured that he had the most rapid communication that could be devised at that time. This was the forerunner of the American Pony Express. Communications could be sent by this Pony Express from the China Sea to the Baltic in 11 days. The Roman Empire could not have extended without the building of good roads for good communications. One can cite other empires which have existed since and who succeeded because of good communications. In modern times we have developed communications to the extent that messages can be sent almost instantaneously from one end of the earth to the other. The development of communications in recent history has not been paralleled by its use as a developmental tool. Communications has for the most part become a monopoly of governments and an important source of revenue in many cases. This has tended to limit the potential usefulness of modern communications not only for the public but also for the very governments who need to use them for both administrative and developmental purposes. The future economic potential of which will far outweigh its short term revenue benefits. In the Pacific, this bureaucratic control of communications has slowed the development of island states which often consist of scattered communities widely separated either by water or wild terrain. This inhibitive control still exists inspite of the tremendous technological advantages which could be put to use to bring these communities into the developmental plans of their countries.

I do not believe that anyone can argue that development - economic, social and political - needs communications. People must be able to communicate easily and freely with others in their own country and overseas.

Telecommunications is a major part of the communications picture. Under this general heading comes telephone and telegraphic services, broadcasting services of both sound and television, radio or radio satellite services set up specifically for conferencing within a nation or internationally, radio services for facilitating air, sea and land transport and the world wide amateur radio services.

All these services can and do play a major role in development and have contributed in no small way to the rapid economic and technological developments of this century.

Although telecommunications technologies have been serving the world for most of this century the development of many small countries has been delayed by the inappropriate manner in which communications have been introduced, usually by outside interests trying to do things in a way that might work well in large affluent countries but that are inappropriate in small undeveloped countries like ours. Thus, for many generations the benefits offered by the natural resource of the radio spectrum have been lost to us in the overall pattern of our development.

When in 1945 I returned to the Cook Islands as a medical officer I found a rather anomalous situation. Certainly all islands were equipped with radio communications. But only telegraph traffic could be sent and received. And at a very high cost. It was more expensive to send a telegram to a neighbouring island like Atiu or Mangaia from Rarotonga than it was to send one to London or Ottawa.

In fact, a 600 word telegram to a relative in Aitutaki would have cost the whole year's salary of a junior school teacher or Government office clerk. Even Government departments could not budget for more than a mere minimum of messages to outer islands. So without much traffic besides weather reports the Government radio service made an annual loss. The whole concept of user pays will not work when the user has no money. But if the service was provided freely the chances are that increased use would lead to economic development which would be of far greater benefit to the nation than the cost of providing the service.

When a radio telephone service was suggested the idea was violently opposed. "It would interfere with our telegraph revenue - we would never allow it", was the cry.

Later when a broadcasting service was suggested the same brick wall was erected. If there was a broadcasting service someone may send a message over it to an outer island relative. This would be stealing telegraph revenue and so could not be tolerated.

So the country was not to communicate - or develop.

Fortunately for the Cook Islands a small but enthusiastic group of radio amateurs made its appearance after World War II. Building their own equipment, mainly out of parts available as surplus, they quickly showed how simple and effective radio telephone circuits could become and how easy it would be to establish a broadcasting service at relatively low cost. Several local persons, including myself, became interested and soon qualified as amateur radio operators and built their own equipment.

In 1954, following strong recommendations by a visiting economic development mission, a broadcasting service was started. But a transmitter was made available only to it for half an hour a week. This was at least a start and a few years later the local amateur radio club acquired some surplus radio equipment that the New Zealand Navy had intended dumping at sea. With parts from this plus some scrounged or found equipment from elsewhere, such as in a Pago Pago rubbish tip, club members got together for a five day holiday and built a broadcast transmitter which enabled Radio Cook Islands to start daily broadcasting. Later more transmitters were built and the service was extended. For many years now Radio Cook Islands has served outer islands on M.F. and H.F. for 17 hours daily. This has included special broadcasts to schools and to school teachers, special broadcasts to farmers, broadcasts to the public on aspects of health as well as keeping the people informed of shipping and aircraft movements, both so important to development.

When I became head of the Government in 1978 I saw that changes were urgently needed in the communications infra-structure. Shipping services to remote islands were made more frequent. Air services were established to all islands within 200 miles of the capital. Public radio telephone services were extended to all islands.

Economic development was dependent on better circuits to the outside world. These needed urgent updating and despite opposition from our traditional overseas advisers we signed an agreement with the British firm of Cable & Wireless to establish and run a satellite earth station. This became operational early in 1980 and since then there has been a spectacular increase in telephone and telegraph traffic to and from overseas. Also, despite the lowest charges of any Pacific country for telephone calls to New Zealand, the operation of the Standard B Earth Station is a success and the Government is enjoying a substantial annual revenue in royalties as against a big annual loss experienced previously.

However, existing Government radio services to outer islands remained costly and rather cumbersome. Government could not wait for projected improvements and so started 1979 with a new radio service using amateur equipment on suitable fixed frequencies to link all outer islands administrations to Rarotonga and each other. Today this service handles an average of forty telephone patches daily between administration officials and about a dozen conference sessions weekly for Government departments and community organisations. This service is not charged for but its value in economic development far exceeds its annual running costs. Besides the main control station in Rarotonga which is run in conjunction with my department's PEACESAT Terminal (Pan Pacific Education and Communication Experiment by Satellite), I have stations in my office and at my home. I can, through them, talk to any person in the nation anytime with very short notice. I am perhaps unique as a head of Government in having a complete radio station on my office desk.

Despite gloomy predictions by telecommunications authorities that these free services would cause them great losses, the public traffic has increased, a natural result of increased economic and social development.

Just as this service has generated increased public traffic, so has the Pacific wide PEACESAT Network. Frequently expressed misgivings about the effects of PEACESAT by telecommunications authorities have always proved wrong. PEACESAT has generated more public telecommunications traffic than it has taken away.

The Cook Islands PEACESAT experience has been outstanding. Almost daily, Cook Islanders from many sectors of the community have been involved in Pacific wide conferences and many of the subjects discussed and learned at these sessions have been able to be put into practice to our national advantage.

Between 1947 and 1952 I used amateur radio to keep up-to-date with developments in the medical field. More recently PEACESAT has done this for local doctors as well as always providing expert advice when needed and aiding in Pacific wide co-ordination of epidemics in cholera, dengue fever and Ross River fever.

The lead in the Cook Islands over other Pacific nations in the introduction of photo-voltaics for home electric supply has been made possible through PEACESAT sessions on alternate energy. New plant introductions leading to new export crops have resulted from PEACESAT and in the social field many activities have benefitted and many organisations have found a new and wider Pacific regional context.

PEACESAT was started in Rarotonga in 1972. Professor Nose of the University of Hawaii and a very keen amateur had designed and described the conversion of two meter amateur equipment for use with ATSL to provide low cost terminals. In contacts with Cook Islands Amateurs he suggested their participation. Two Cook Islands amateurs, using surplus scrap, built a terminal at no cost to anyone in record time. The terminal has been improved but still consists of home built equipment. Today the Cook Islands terminal has been used by 10% of the people of Rarotonga. It provides our news services with the only available news of the Pacific region. It has allowed participation of local political figures in overseas Press Conferences and has assisted the Cook Islands to organise and jointly conduct with overseas scientists much more scientific and medical research than would otherwise have been possible.

Our thanks go to NASA, to John Bystrom of the University of Hawaii and the State Government of Hawaii for making PEACESAT possible.

The ATSL communications experiment was one of the most successful and appropriate to the Pacific of any. Yet, the U.S. Government, in common with all other world governments, rejected the Cook Islands proposals put forward at WARC 79 which would have made the same appropriate satellite technology available in the future. Let us hope that some special WARC in the near future may reverse that situation. As it stands now only radio amateurs can use the VHF or low UHF frequencies for satellite communications, no other services.

There are many advantages to be gained in any developing country by encouraging a strong amateur radio service. Not only does the amateur service save many lives by providing emergency communications when required, it also results in a well trained and experienced technical group in the nation and improves the general knowledge and language proficiency of island people who participate in it. Measures on the part of a Pacific Island government to encourage amateur radio will always pay off and I would like to mention our appreciation of the Japanese Pacific Society for their recent gifts of complete amateur radio stations to a number of Pacific countries.

Perhaps here I could mention two amateur radio dramas in which I was personally involved. Both were back in 1947.

A Cook Islands auxiliary sailing vessel was in trouble. The engine was out of action, the position of the vessel was not known to within about 30 miles. She was leaking and water had already covered the main batteries and rendered the radio inoperative when the Captain called for help on his amateur hand cranked transmitter. Pumps were keeping the vessel afloat but more fuel was essential if they were to keep operating.

Amateur communications were maintained with that vessel for 58 hours before it returned safely to port. On the first night I helped build a direction finder which got bearings on the ship and next morning sailed on a rescue vessel to take the needed fuel. Communications continued via amateur radio with both vessels and with two search aircraft. Official attempts at communications all failed and without amateur radio the ship and its complement would have been lost.

The second drama was that associated with the end of the historical voyage of the Kon Tiki raft on the reef at Raroia Atoll in French Polynesia. The raft had contacted an amateur in Rarotonga several times a day for the whole of its voyage using the simplest of equipment possible, a small hand operated morse code transceiver. On its last contact the raft reported that it was approaching the reef on which there were breakers 25 feet high. Would we listen for 36 hours before calling for assistance. For 36 hours I joined with other Cook Islands amateurs in a listening watch on four possible frequencies. Then one station started sending a pre-arranged distress message. A few minutes later the station I was at contacted the raft's transmitter - completely rebuilt ashore. I made a mad dash by car to where the distress call was being sent and its abrupt ending and announcement of the good news was a very dramatic moment in the history of radio.

I was not in the Cook Islands when solo raftsmen Wm. Willis ended a four months drift voyage from South America in Pago Pago. He might never have been heard from again if a Cook Islands amateur operator had not heard his distress call when he was near Pago Pago but drifting away. Quick contact with the coastguard in Pago Pago resulted in his rescue. No-one else had heard his call.

Recently amateur radio played a big part in getting a dismasted Austrian yacht safely into Aitutaki with less than a gallon of fuel left.

But let me change the subject and say a little about the appropriateness of equipment for Pacific Islands use. All means of communication have developed simultaneously. Cables have carried more and more circuits under the sea and soon an optic fibre cable will span the Atlantic carrying 36,000 voice circuits. High frequency radio has improved with better filters, much higher energy efficiency, better frequency control and flexibility and lower relative costs.

Satellite communications as provided by Intelsat have made international links within the Pacific region efficient, reliable and less costly. In other words, all technologies have improved.

It is quite appropriate for Rarotonga, as a national centre, to have a Standard B Intelsat

Earth Station to carry all international traffic, although the big investment of several million dollars means that charges are currently higher than, it is hoped, they soon will be.

But for Pacific wide conferencing with low traffic density where the communications are to aid development and cannot be charged to a technology using VHF on a satellite like ATS1 with hemispherical coverage and low cost terminals that can stand up for years on an isolated island without air-conditioning and only solar power supplies is obviously very much more appropriate. And for inter-island communications within a group High Frequency radio, used with frequencies most appropriate to the propagation conditions at any particular time take a great deal of beating for efficiency and economy. Modern amateur radio equipment has advanced rapidly since the late 1970's. My latest transceiver can be tuned to and locked on any frequency in the medium and high frequency ranges and read out with great accuracy. It will receive and transmit on upper sideband, lower sideband, C.W., amplitude modulation and RTTY. And on sideband it has a peak power of nearly 200 watts. And all this for less than \$1,000.

Unfortunately, there are world-wide regulatory problems that make H.F. fixed services less effective than they should be. A point to point service often has problems of interference from stations on the other side of the world using hundreds of kilowatts. But one cannot shift from the frequency, an amateur station on the other hand operates in a band of frequencies and is never faced with interference within that band of more than the amateur 1 kilowatt limit. If interfered with he can always shift to a clear spot, as a result amateurs can maintain scheduled services all over the globe. I ask why can't fixed services in small countries be given small bands of frequencies free of high powered interference just as amateurs are?

Some regulations governing the design of transceivers rule out the use of amateur equipment even when it is known that amateur equipment will work better, have better frequency stability, more power for a given expense and will cause no interference to other services.

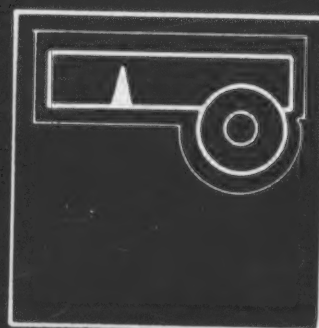
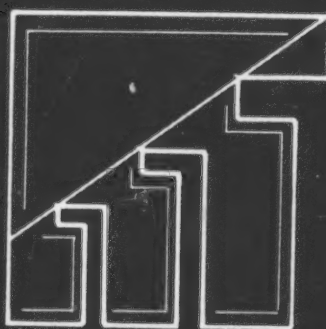
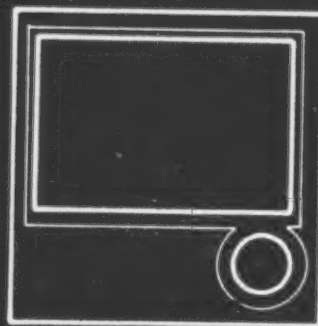
One way of perhaps overcoming these problems is to share amateur bands where permissible with fixed services. This is done now in French Polynesia, Fiji and Vanuatu and possibly other Pacific countries. Australia reserves some amateur frequencies for fixed station use but apart from end of band frequencies, New Zealand who represents us at the ITU has not permitted our shared use.

Finally, let me appeal for a liberalisation of the regulations so that use of the natural resource of radio communications will lose many past restrictions, let me appeal for reductions

in cost to the user of international communications services as quickly as technology permits and for manufacturers to consider the different requirements of small isolated areas.



Monday, January 18:
Plenary Session
Basic
Telecommunications
Services



CASE STUDY:
THE CHILEAN TELECOMMUNICATIONS SYSTEM—ITS CONTRIBUTION TO
THE COUNTRY'S DEVELOPMENT AND ITS PROJECTION IN THE PACIFIC AREA

Jefe Administracion Chilena de Telecomunicaciones
Chile

1. GEOGRAPHY, POPULATION AND CLIMATE

Chile, with a continental area of about 750,000 sq. km.—excluding the Antarctic territory—is a long, narrow ribbon of land stretching almost 4500 km. along the southwestern coast of South America. With an average width of about 180 km., Chile extends from 180 degrees to 56 degrees south latitude, bordering Peru in the north and Bolivia and Argentina in the east.

Besides its 4500 km. long coast, endowed with many ports (Valparaiso, Antofagasta, Talcahuano), the Chilean presence in the Pacific comes from the possession of numerous islands, especially Easter Island (27° S and 109.5° W) which projects Chile into Polynesia.

Furthermore, all natural waterways linking the Pacific to the Atlantic, i.e., the Strait of Magellan, the Beagle Canal and the Drake Passage (Cape Horn), are under Chilean sovereignty.

There are five distinct and well-defined geographic regions: the Northern Desert, the high Andean Sector, the Central Valley, the Southern Lake District and the Archipelago. Wedged between the high Andes Mountains in the east and the somewhat lower coastal mountains, the fertile central valley houses most of Chile's agriculture and population. Its nearly 12 million inhabitants are mainly urban. Santiago, Valparaiso and Concepcion are the most important cities.

Climate varies from the northern deserts to the Antarctic. The presence of the cold Humboldt current off the coast and the relatively short distance between the coast and the snow-covered Andean peaks moderate what might otherwise be a very warm climate in the Santiago area. Summer (December-March) is long and dry; the rainy season is from May to August. In the lake region, it is colder and wetter. In the far south (Tierra del Fuego) summers are short and cool, and winters are long, cold and wet.

Its peculiar shape and its location far from the main political, commercial and industrial centers have obliged Chile to undertake considerable effort to link the distant parts of its territory to one another and to overcome its geographical isolation by a costly transportation policy, ranging from the first railway to be operated in South America to the modern ports, subways, highways and airports of present Chile. Although the country has made great progress, mainly in the last few years, in the field of telecommunications, especially in international services, there is still a lot to be done to meet the needs of the present and future.

2. STRUCTURE OF TELECOMMUNICATIONS

The Subsecretary of Telecommunications, an organ of the Ministry of Transportation and Telecommunications, was created to act as the chief policy-maker and spokesman for all aspects of communication policy. It is the highest technical and normative authority in its field. The Subsecretary is the "Chilean Administration of Telecommunications," responsible for policy development and advocacy in the international field.

An integrated and interconnected system of three state-owned telephone companies satisfies the most urgent and fundamental needs of Chile's individuals and organization, both private and public. Compania de Telefonos de Chile operates over 380,000 lines and 550,000 telephones throughout almost the entire country. Two minor companies, Compania Nacional de Telefonos de Valdivia and Compania de Telefonos de Coyhaique, operating in the X and XI regions, have about 18,000 telephones.

Long distance transmission, both domestic and international, is effected mainly by Entel Chile (Empresa Nacional de Telecomunicaciones S.A.), a state-owned company. Its microwave network and satellite transmission link all continental, insular and Antarctic Chilean territories. Countless links complement this network. Almost all international communications are affected by Entel, some by means of ground facilities, others by link with Intelsat and soon with Inmarsat.

National telegram and telex services are provided by the state-owned Empresa de Telegrafos del Estado, while international telegram and telex services are provided both by said state-owned company and several private companies, such as ITT-COM and Transradio Chilena.

In the field of broadcasting, Chile has over 300 radio stations, almost all of them privately owned. As this activity is considered to belong to the private sector, the Chilean state has very limited participation.

The contrary is true with television: Television Nacional de Chile, a state-owned and directed institution, reaches to the farthest point in the territory and to almost all its inhabitants. At the same time, four television corporations owned by several Chilean universities, operate in some cities, such as Valparaiso and Santiago. Privately owned TV stations have not obtained legislative approval.

A wide range of private telecommunications services fills the gap between the above described supply and the everchanging and ever increasing demand for specific telecommunications.

3. NEW ECONOMIC POLICY

Chile has undergone a deep change in the last eight years. Becoming aware that Chile's real problem had been the extremely low rate of growth of its economy (almost the same as the growth in population), the Chilean state decided on a dramatic change in its economic policy, aimed at obtaining a high and sustained rate of growth of the national product.

Private companies, both Chilean and foreign, were given ample possibilities in almost all kinds of business; the economy was opened to world trade; the economic activities of the state, although still dominant in many fields, were severely restricted. In short, a modern and efficient free market economy should help to modernize and develop the country.

Now, after some hard years, the country can be proud of its achievements: inflation has been brought down from an estimated 1000% in 1973 to less than 12% in 1981, growth rates of over 6% could be achieved during five years without the customary balance of payments problems, the excessive dependence on copper exports was diminished by doubling non-copper exports. But certainly the most important figures refer to social improvement: infant mortality, illiteracy, malnutrition, unemployment have all fallen, due to specific and scientific programs we directed to help the very poorest of our people.

The telecommunications sector, because of its essential role in the social, cultural, economic and political development, has not been absent in the steady progress of the last years. Substantial increases in all kinds of services have been added to the existing ones. For the near future, moderate estimates refer to an investment of over US\$2 billion during the next 10 years. The telephone network is to be expanded from its present 580,000 subscribers to over 1,500,000 by 1990, thus increasing the telephone coverage from 5.03 to 14.0 per 100 inhabitants. Similar increases will be necessary in all other existing services, i.e., telex, long distance, data transmission, etc.

The telecommunications development strategy calls for ample participation of private companies in the operative sector, besides the state-owned enterprises, in order to obtain the necessary investment and to increase the supply of services. Consistent with the overall economic policy, this approach is expected to create a modern and efficient system.

4. CHILE'S PROJECTION IN THE PACIFIC BASIN

Geography, history and economy have made Chile a maritime country. During the 19th Century Chile had an active presence in the Pacific Ocean and came to be considered a maritime power. It had a very important trade with California and the West Coast of America. A Chilean possession in the midst of the Pacific Ocean, Easter Island, is a symbol of those bold Chilean sailors. Before the opening of the Panama Canal, navigation from the Atlantic to the Pacific and vice versa was done through the Magellan Strait.

The latter together with the Beagle Canal and the Drake Passage are the only natural waterways linking the Pacific and Atlantic Oceans; the three of them are under Chilean sovereignty. Consequently, Chile's presence in the Pacific is enforced by its continental (American), insular and Antarctic possessions.

On the other hand, since the Pacific Basin is surrounded by the countries with the biggest population in the world, it may be expected to become as important as those countries.

Furthermore, the northern Chilean ports of Arica and Antofagasta are the natural windows for the trade between the Pacific and the South Atlantic countries of South America.

In contrast with the notorious increase in commercial exchange between South America and the Far East countries, there is no direct telecommunications, which has to be effected via the United States/Canada or via Europe. We have been studying this problem and its possible solutions, and we believe that it could be discussed with other interested countries within the Pacific Telecommunications Council. (1)

Finally, we think that Easter Island, 3,000 miles from South America, could become the appropriate telecommunications link in the South Pacific, as Hawaii is in the North Pacific. Chile is about to install new facilities for domestic telecommunications between the continent and Easter Island, which would be a convenient point to operate telecommunications via satellite.

Because of the mutual benefits for all its members, it has been a pleasure for Chile to participate in the activities of the Pacific Telecommunications Conference. As a member of the Pacific Telecommunications Council, we feel completely identified with the Council's purposes.

5. NOTES

(1) One possible solution, according to present-day technology, would be the positioning of geostationary satellites situated so as to allow South America to communicate directly with the East Pacific and South East Pacific countries.

Basic
Telecommunications
Services:
Technical
Considerations

An Introduction to Data Communications

in Taiwan, ROC

Huang, Shiow Yuan

Abstract

The data communication service in Taiwan, ROC, was started in 1971. Since then, the demand for data communication service has been kept high growth rate. At the end of 1980, there were about 660 circuits in service. In the recent years, the rapid growth of the computer applications in this country has caused the demand of data communication more urgent day by day.

In this paper, we mention the present status of the data communication service in this country first. Then we talk about the projects undergoing, specially, the constructing circuit-switched public data network and the developing packet-switched public data network.

1. INTRODUCTION

The data communication Service in Taiwan, Republic of China, was started in 1971 by TTA(Taiwan Telecommunication Administration). Since then, the demand for data communication in Taiwan has increased rapidly. In 1980, there were about 660 circuits in service, and the growth rate has been about 50%(1).

Up to the present, only leased circuit service was provided. However, the circuit-switched data service is scheduled to open in August 1981. The domestic packet-switched public data network is also being developed and scheduled to be available in July 1984. Besides, it is also planned to open new data communication service, such as videotex and teletex in future.

2. SERVICE PROVIDED AT PRESENT

2.1 Leased-circuit service

Leased-circuit service is divided into 5 categories as shown in Table 1. So far, the service is limited in the voice grade, i.e. up to 9600 bps. However, wideband service, 64 Kbps, will be offered in the near future.

Figure 1 and 2 show the trend of the circuit number. In 1980, the number of circuits in service were about 660, and the growth rate was about 50%(1). It is also expected the number of circuits will reach 3300 in 1985.

Figure 3 shows the trend of the distribution of circuits in service.

In 1980, there were about 38% circuits in the speed of 2400 bps. And the demand for high speed circuit is increasing.

2.2 Universal data Access Service(UDAS)

In December 1979, the International Telecommunication Administration(ITA) opened a service for the access of data base in the host computer in U.S.A., called Universal Data Access Service(UDAS). Figure 4 shows the network configuration. At the first stage, the system can provide 16 asynchronous ports and 4 synchronous ports.

At the end of 1980, there were 15 subscribers: Continent Bank, ITRI, Bankers Trust Co., Westinghouse Co., Taiwan Normal University, General Instrument Co., American Express International Banking Co., Science & Technology Information Center of National Science Council, American Bureau of Shipping, Bank of American and Citibank., etc.

3. PROJECTS UNDER CONSTRUCTION

3.1 Establishing Wideband Circuits

To meet the demand for high speed data communication between computers, TTA is engaged in establishing many wideband circuits in the speed of 64 Kbps and planning to open them to service as soon as they are completed. Table 2 shows a list of the long distance wideband circuits under construction. It is scheduled in the middle of 1983 to complete these circuits.

3.2 Circuit-Switched Data Service by EDS Telex/Data Network

The switching system of the telex/data network is an SPC(store program controlled) electronic switching, called EDS, which is manufactured by Siemens, Germany. EDS is used as data switching in a speed up to 9600 bps. Figure 5 shows the network configuration.

Table 1. categories of Leased-Circuit Service

Speed	Description
≤300 bps	Speed less than 300 bps, asynchronous
600/1200 bps	600 and 1200 bps, asynchronous and synchronous
2400 bps	2400 bps, synchronous
4800 bps	4800 bps, synchronous
9600 bps	9600 bps, synchronous

Table 2. Long Distance Wideband Circuits under Construction

Cities to be connected	Speed	Number of circuit
Taipei-Taichung	64 Kbps	3
Taipei-Kaohsiung	64 Kbps	3
Taichung-Kaohsiung	64 Kbps	2

Table 3. The Circuit-Switched Data Service by EDS Telex/Data Network

Speed	up to 9600 bps(300,600/1200,2400,4800 and 9600bps)
User facilities	Direct Call Abbreviated Address Calling Closed User Group Calling and Called Line Identifications Multiaddress Calling Reverse Charging
Interface	X.20 & X.20 bis for a synchronous terminal X.21 & X.21 bis for synchronous terminal
BER	$\leq 10^{-10}$
Connection Time	≤ 50 ms

Table 4. Predicted Number of Terminations on Circuit-Switched Data Service

Speed(bps)	1981	1982	1983	1984	1985
300	84	118	147	185	200
600/1200	179	250	347	431	490
2400	200	298	436	508	546
4800	52	94	146	170	196
9600	10	24	46	77	118
Total	525	784	1120	1371	1550

Table 5. Service Terminal Type

Item	Packet mode	Non-packet Mode	
		Asynchronous	Synchronous
Physical interface	X.21(X.21 bis)	X.20(X.20 bis)	X.21(X.21 bis)
Transmission Procedure	LAP, LAP/B (X.25 level 2)	Start-Stop	BSC SDLC
Network Access Procedure	X.25 level 3	PAD:X.3 DTE-PAD:X.28 PAD-PT:X.29	NO
Speed	2400, 4800, 9600, 48K	110, 200, 300, 600, 1200	1200, 2400, 4800, 9600
Service Type	Permanent Virtual circuit Virtual call Closed user group one way virtual call	Permanent Virtual circuit Virtual call Closed user group one-way virtual call	Permanent Virtual circuit Virtual call Closed user group one-way virtual call
Facilities Available	reverse charging	reverse charging abbreviated address direct call	

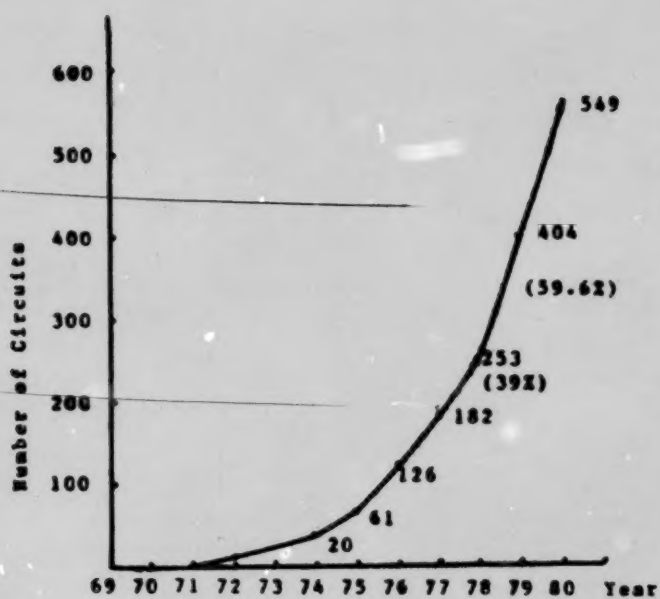


Fig. 1. Number of Leased Circuits

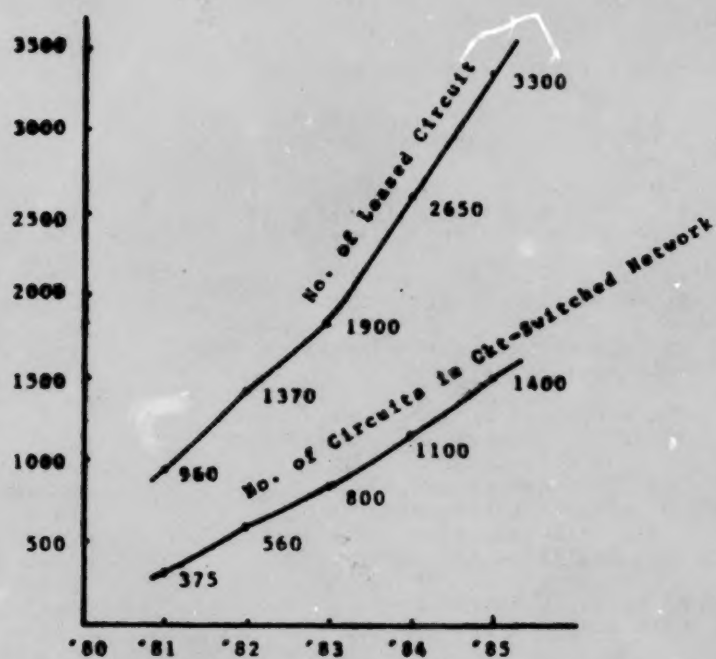


Fig. 2. Predicted Number of Circuits, 1981-1985

The network includes switching centers and concentrators. The users near to switching center are connected directly to it, others are connected through concentrator near to them. In the first stage, the network will include 1 switching center located in Taipei and 4 concentrators located in Taoyuan, Hsinchu, Taichung and Kaohsiung to provide the service for about 1000 users.

It is scheduled to open the circuit-switched data service by EDS telex/data network in August 1981. Table 3 lists the summarized characteristics. Table 4 shows the predicted number of its termination(6).

The circuit-switched data service by EDS telex/data network is scheduled to be opened in August 1981.

3.3 Developing Packet-Switched Public Data Network

To meet the requirement of high speed and high quality switched service, a packet-switched public data network is being developed(1,4-6).

In the first stage, the network(shown in figure 6) will include 1 NCC(Network Control Center), 3 SP's(Switching Processor), and 40 AP's(Access Processor)providing service for about 2000 users.

NCC is the network control and management center. Its functions include:

- a. to accept operation command for
 - . network reconfiguration
 - . reversion of operator program for AP
 - . initiating loop test and trace procedure
 - . setting time
 - . collecting billing information
 - . reporting the statistical data
- b. to monitor the status of AP, SP and communication link.

SP is a packet switching system with duplicate processor.

The functions of SP are as follows:

- . transportation of packet
- . flow control
- . network monitoring
- . down-line loading of AP
- . measuring SP & communication link utilization

AP is an interface and data concentration unit with the following functions:

- a. data concentration
- b. user interface for the following protocol
 - . HDLC
 - . basic mode

- .start-stop
- c. health checking
- c. network access procedure protocol
 - . level 3 of X.25
 - . PAD(packet assembly/ disassembly),X.3

The following features will be provided in the network.

- a. Terminal Types
The network can serve two kinds of terminals, packet mode(X.25) and non-packet mode(start-stop and basic synchronous mode), as shown in Table 5.
- b. Speed
up to 48kbps(details as shown in Table 6)
- c. Service Type
The network provides two kinds of basic connection mode:
 - . virtual call; and
 - . permanent virtual circuit

It is scheduled to complete the network development in July 1983.

3.4 Planning for New Data Communication Service

Videotex and Teletex are two major services which are being developed. The former allows subscribers to access private and public data bases interactively and receive all kinds of information on the TV screen, and the latter combines the functions of "word processing" and "text communication" into a new communication form as new technologies make telex better suited for office environments than before, on the first stage, the existing circuit-switched network will be used to provide the service. However, the goal is to establish an integrated service digital network(i.e. to integrate circuit-switching and packet-switching into one network) to provide all kinds of the new service.

4. CONCLUSION

Data communication service in R.O.C. began in 1971. At present, it provides lease-circuit service only. However the annual growth rate is quite high. The demand for data communication increases very rapidly.

Circuit-switched data service will be provided in August 1981. Packet-switched public data network, a new impact for data communication, is now under developing.

In the near future, the data communication service will become an important service of the telecommunication in R. O. C.

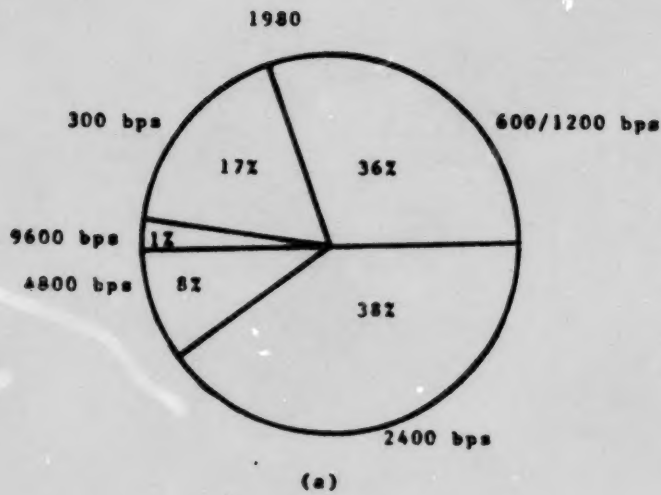


Fig.3. Distribution of Circuits

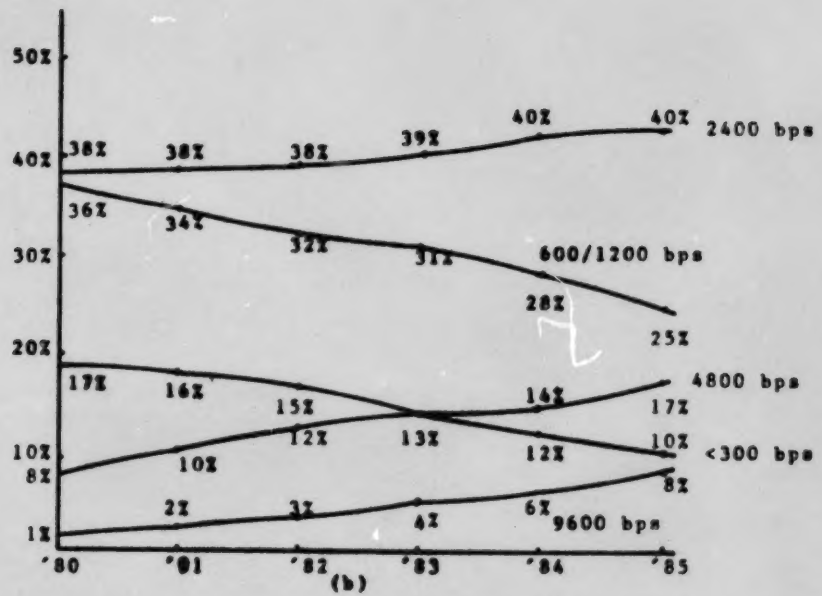


Fig.3. Distribution of Circuits

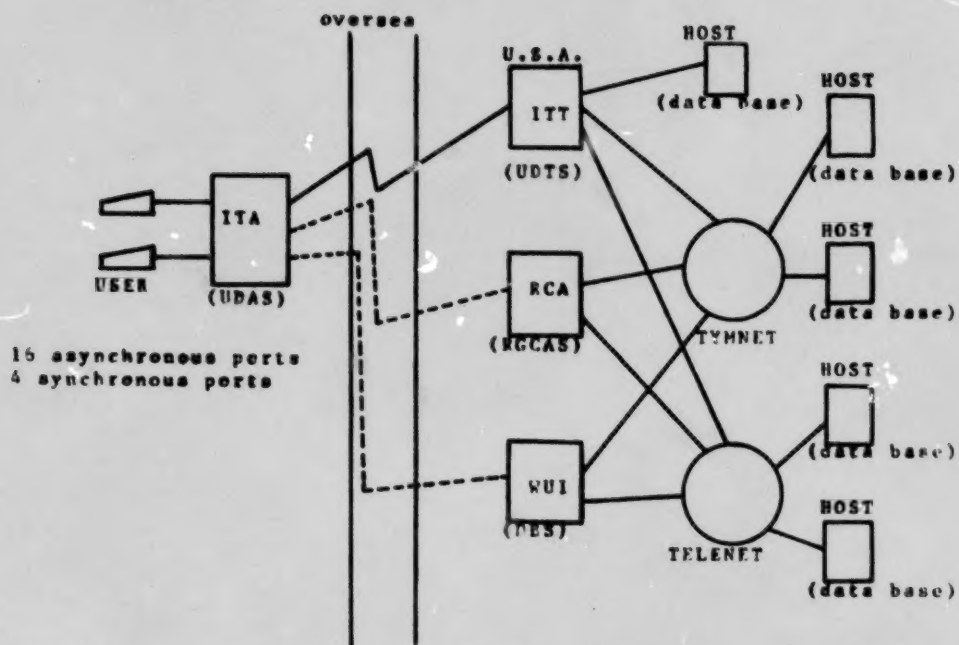


Fig. 4. UDAS

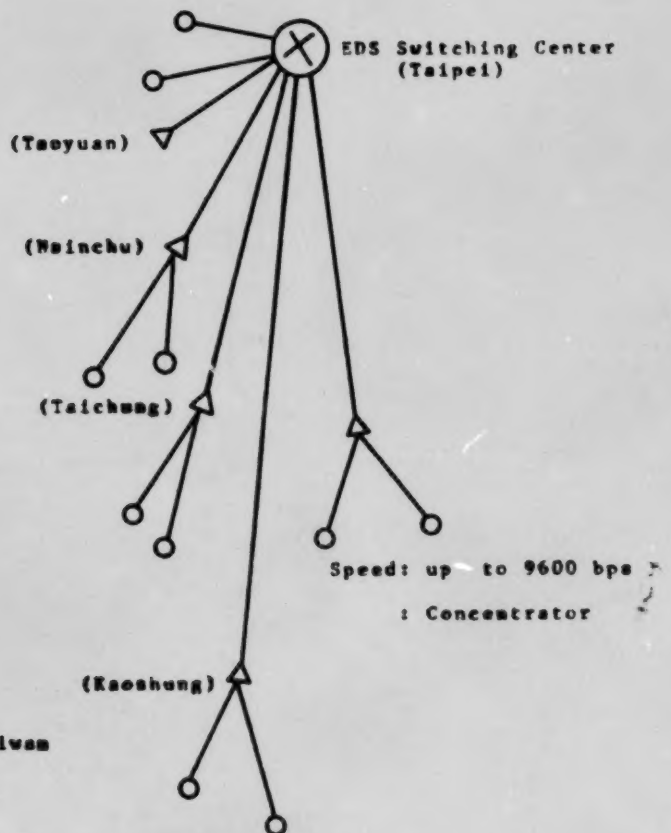
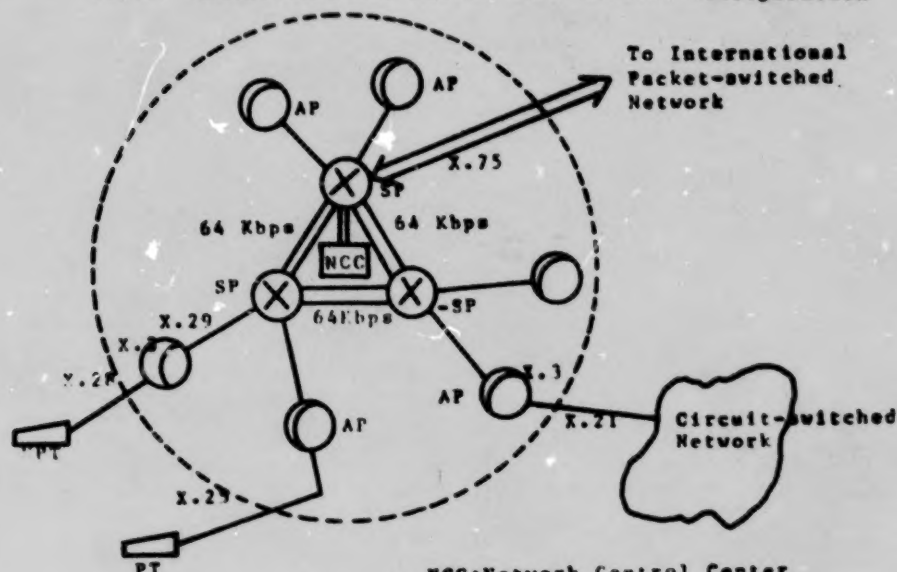


Fig. 3. EDS Telex/Data Network in Taiwan

Fig. 8. Packet-Switched Public Data Network Configuration



NCC: Network Control Center
 SP: Switching Processor
 AP: Access Processor
 NPT: Nonpacket terminal
 X.3, X.21, X.25, X.28, X.29, X.75
 CCITT Recommended Communication Protocol.

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THE PRESENT AND FUTURE ROLE OF WESTERN UNION IN THE PACIFIC AREA

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The Western Union Telegraph Company has been in business for more than 130 years: probably the oldest, and certainly, the most historic telecommunications organization in the world. The growth of Western Union has proceeded hand-in-hand with the expansion of the United States itself from the mid-nineteenth century to the present.

When Western Union began operation, there were 50 other small telegraph companies... and messages were transferred physically from one company to another at a rate as high as \$20 for a single telegram.

Over the years, Western Union has built one of the most modern telecommunications systems in the world. Today, it moves information for business, government, and the public. Its services range from the traditional telegram -- to computerized networks that speed messages and data to thousands of destinations simultaneously. It is that capability, that expertise, that we offer here today as we discuss the future of telecommunications in the Pacific.

Western Union has been known primarily as a domestic telecommunications company; domestic in the sense that its services were confined to the North American continent. Hawaii, separated as it is from the mainland United States, has, until recently, been classified as an international point for record telecommunications services. U.S. Federal law confined Western Union to providing only the "domestic" portion of the international record services through interconnection with established "international record carriers" (IRCs). However, a recent change in the law has made Hawaii an integral part of Western Union's network.

It is important to realize that Western Union provides a much broader range of basic services than is now generally available. We plan to make this "broader range of basic services" available between the U.S. and all countries.

In addition to Telegram, Telex, and Private Wire (or leased channel) services, Western Union provides a 'menu' of other basic services to its customers which are not available from other companies. These include: Mailgram, FYI (News Service), Money Order Service, RediList, Nitecast, and Metro I telephone service.

Mailgram, provided in conjunction with the U.S. Postal Service, permits any company or person in the United States to transmit a 100-word message, at low cost, via Western Union, for delivery in

the next business day's mail. Introduced ten years ago, Mailgram message service is now a \$120 million business for Western Union.

Within the past two years Western Union has become aware of a growing "international" interest in Mailgram. As a matter of fact, British Telecom will shortly introduce such a service to the public of the United Kingdom. Western Union and the U.S. Postal Service were pleased to provide assistance and support to our British colleagues in making this service possible. By adopting standardized protocols, procedures and formats, it seems logical that Mailgram can quickly become a worldwide service. Such service should be of particular interest to countries of the Western Pacific region.

Because of the substantial time zone differences with the United States, many of these countries have expressed a reluctance to abolish the outdated Letter Telegram (LT) services. Nonetheless the global trend inevitably leads in that direction. Mailgram is a natural substitute for the overnight telegram service. It is priced more attractively, and has fewer restrictions on language flexibility. Western Union's technological expertise and experience with Mailgram give it a unique capability to assist nations in developing their own Mailgram type service, for both "domestic" and "worldwide" use.

FYI (News Service) is the generic term -- though not an official tradename -- given to Western Union's low-cost, low-speed interactive database service. In contrast to other carriers' networks, Western Union's "telex terminal" is in reality a "data terminal". With no additional investment in equipment or software, all 140,000 subscribers on our national telex network have immediate access to Stock Exchange quotations, news bulletins, commodity prices, precious metals reports and currency reports; in fact, 41 categories in all. Because of FYI's compatibility with worldwide telex standards, this unique service is available now to all countries at regular international telex rates.

Supported by a network of 8,500 offices and agencies, Western Union Money Order Service is available to both private individuals and commercial firms. Persons may transfer up to \$1,000.00 anywhere within the United States, Canada, Puerto Rico and the U.S. Virgin Islands using Master Card or Visa credit cards. Money Order Service is also available from the United States to Mexico. Just recently the service went "transcontinental" to Europe, via the Girobank system in the United Kingdom. This Western Union Worldwide Money Order

Service may prove attractive to those Pacific countries with large "expatriate" populations now residing in the United States.

RediList is a service whereby customers may "pre-Store" computerized address lists with Western Union. It is a "subscription-only" service which permits automatic delivery of single messages to multiple addresses at the same time. Message delivery may be accomplished by telex, telegram or Mailgram, depending on the sender's instructions.

NiteCast is essentially a similar service to RediList except that broadcast-transmission takes place during the "off-peak" or night hours at very low rates.

In 1980, Western Union took its first step into the competitive "voice" communications market with the introduction of METRO I - a long distance inter-city telephone service at rates below the present Bell System charges. Currently Metro I is available to telephone subscribers in 51 major metropolitan areas who can place calls to 140 cities nationwide.

To function successfully -- and profitably -- in a competitive telecommunications environment, it is necessary for any company to maintain a continuing series of new and innovative products and services. Western Union is no exception. In looking at the current state of the art for low-speed transmission of text and graphic communications, we became convinced that it was time for Western Union to play "match-maker" (or marriage broker, if you will).

Side by side with our 140,000 telex subscribers in the United States there exists an equally large network of facsimile terminals of the "analog" variety. Until recently neither network was compatible with the other. A unique service concept is now undergoing a market test in several parts of the country. We call this service WUFAX. It permits telex subscribers to transmit messages to analog type facsimile terminals and from such terminals to telex terminals. The format has been successfully tested from overseas countries into the Western Union network. Once again, we believe we have successfully brought to market an "enhanced" telecommunication service at no additional cost to the consumer. Laboratory testing continues at this time on refining the technology of WUFAX in order to accommodate the high-speed "digital" facsimile terminals now proliferating in the marketplace.

No discussion of future telecommunications services would be complete without reference to Western Union's domestic satellite program. Since 1974, when Western Union launched the First domestic communications satellite over the United States, it has been in the forefront of this space-age technology.

Three Westar satellites now in orbit will soon be joined by two more in 1982. Westar IV, due for launch next month, and Westar V, due for launch in September, will give Western Union the largest number of communications satellites of any private communications company. Industrial and consumer demand is such that capacity on the new satellites is already heavily committed -- so much so that a sixth Westar is already under construction.

The scope and variety of future telecommunication services in the United States is bound to accelerate as "deregulation" of the industry continues. Western Union is prepared to compete vigorously for its share of this new business while providing the full range of established services and, neither are we immune to the impact of new developments in other parts of the world: The planned introduction of "TELETEX" service is of particular interest to Western Union. We plan to enter this new market in the near future.

Coincident with the planning and development of future telecommunication services is the growing acknowledgement of telecommunications as a "national resource" to be directed and managed for the benefit of each nation. The emerging controversy on "trans-border data flow" has already promoted Governmental scrutiny, and will be a crucial factor for discussion during the 1980s.

Western Union, as a provider of database information and the manager of a major telecommunication transport system, will join with all interested parties in reaching a satisfactory resolution of these delicate global problems.

In preparing for the future, it is always instructive to reflect on the past. A decade ago, the management of Western Union made two major decisions that have had a positive impact on the fortunes of this historic company. One has already been mentioned: The launch of the first domestic communications satellite.

The second, was a commitment to a ten-year capital investment program designed to streamline and modernize the entire national telecommunications network of Western Union. Now ten years and two billion dollars later, Western Union stands poised to participate aggressively in the new emerging technologies and services of the post-industrial society, as more than ever, nations depend on telecommunications for fast access to accurate information.

Today in Hawaii, the "natural hub" of the Pacific, we see a vast region of the globe, containing many cultures and societies in various stages of development and linked together by a technology that transcends both time and distance. To achieve the ultimate goal of improving the quality of life for all peoples of the Pacific Basin, and to promote the cause of international peace and goodwill, will require a dedication and commitment from all of us in the telecommunications industry.

The people at Western Union are ready to meet the challenge of providing rapid communications services as they continue to pioneer the new frontiers of communications technology.

Organizations such as the Pacific Telecommunications Council will play an increasingly important role in this challenging task, by providing a continuing forum for the free and open exchange of information, ideas and viewpoints. Western Union pledges its full support and participation in this exciting enterprise. We truly believe the best is yet to come.

TOPOLOGY CONSIDERATIONS FOR
MULTIPLE ACCESS/BROADCASTING RADIO NETWORKS

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Abstract

A radio broadcasting system can be considered as a Network with devices, terminals and stations linked together by broadcast radio channels.

There are two important inherent characteristics in these kinds of networks, which unfortunately make it very difficult to analyze them by "traditional" network analysis.

These characteristics are: 1) Multiple Access/Broadcast Channels
2) Mobil Units

In this paper, the topology analysis is done through the properties of random networks and minimum trees.

I. INTRODUCTION

In this paper is addressed the problem of designing networks which are very difficult to analyze by "traditional" network analysis; this could be due to the full connectivity given by multiple access broadcasting radio networks and users as mobile units. In this paper, the topology analysis is done through the properties of random networks and minimum trees. The properties of the random networks have been shown to provide reasonable guide and performance limits of real networks in some cases, for example, in satellite channels which have the earth stations which are in the coverage area of the satellite. A random network is a network which connects n points placed at random in a certain defined plane.

A key element in the topology analysis of wide area Radio Multiple Access/Broadcast network using terrestrial links is the Radio Repeater. The function of the Radio Repeater is to provide a network for connection of terminals to one or more stations, and providing paths to alternate stations in order to insure reliable communication.

A question raised in the topology analysis for these networks is: What is the optimum or near optimum amount of Radio Repeaters necessary in order to cover a certain defined area. Knowing the repeater range, a superior limit of number of Radio Repeaters is found, based on Random Exotic Trees (not quite minimal) and properties of the radio multiple access/broadcast channels in a terrestrial environment. The analysis here described has the advantage that both the users and repeaters in the network could be mobile units.

II. BACKGROUND

a) Minimal Spanning Tree (MST). A communication network shall be modeled by a linear graph $G = (N, L)$. N is a nonempty set of nodes that corresponds to terminals, stations or repeaters and L is a set of l edges or branches that corresponds to the communication links.

Any graph $G = (N, L)$ is said to be connected if there is at least one path between every pair of nodes $n_1, n_2 \in N$. A subgraph G_1 of G is a graph all of whose nodes and edges are contained in G , i.e., $G_1 = (N_1, L_1)$ where $N_1 \in N$ and $L_1 \in L$.

A subgraph $G_1 = (N_1, L_1)$ with $N_1 = N$ is called a spanning subgraph. In a connected graph G of l edges and n nodes, a spanning tree T is a connected spanning subgraph (consisting of $n-1$ edges) that contains no circuits. The deletion of any edge from a tree clearly results in its becoming disconnected. Furthermore, the addition of any edge to a spanning tree forms a circuit.

A weighted graph is a graph $G = (N, L)$ with a weight associated to each link. A Minimum Spanning Tree (MST) of the weighted graph G is a spanning tree T of G , in which the sum of all the weights is minimum.

The computational problem of constructing a MST has been treated by several authors (KRUS 56), (PRIM 57) (DIJK 59). It is a surprisingly simple computation.

In the construction of a MST an isolated node is a node to which, at a given stage of the construction, no connections have been made. A cluster is a subgraph connected by links, between the members of the subgraph.

Following the Prim algorithm (PRIM 57) for the construction of the MST, there are two principles that can be stated as follows:

Principle 1

Any isolated node can be connected to a nearest neighbor

Principle 2

Any isolated cluster can be connected to a nearest neighbor by a shortest available link

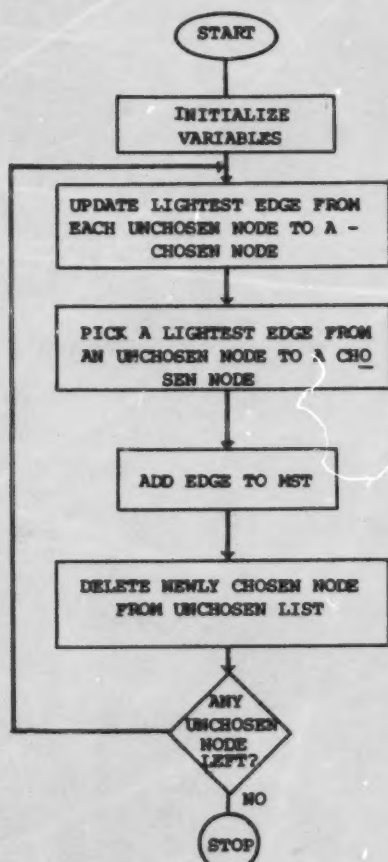
A more detailed explanation of the PRIM algorithm is given by the Flow Chart of Figure 1.

b) Exodic Tree (ET) (GILB 65)

Let n points in the plane be given.

The following construction connects these points by a tree. Call the points $P_1, P_2, \dots, P_n$, choosing the subscripts to order the points according to their Euclidean distances from the origin:

$$||P_1|| \leq ||P_2|| \leq \dots \leq ||P_n||$$

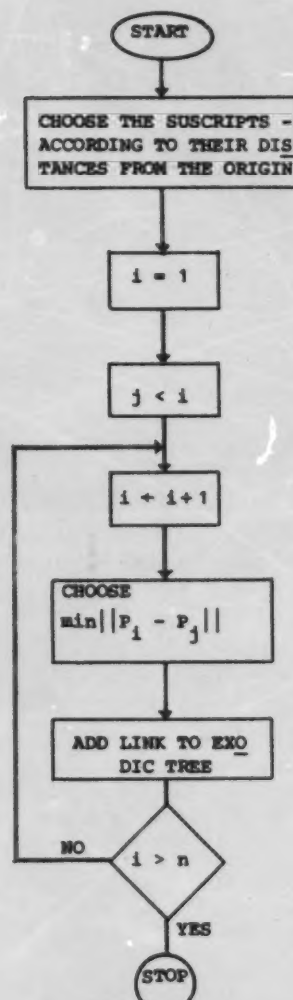


FLOW CHART PRIM ALGORITHM
FIGURE 1

For $i = 2, 3, \dots, n$ connected P_i to a point P_j chosen from $P_1, \dots, P_{i-1}$ to minimize $||P_i - P_j||$. These $n-1$ connections form a tree.

A long a path from the first point P_1 to any other point P_i the intermediate points P_j occur with monotone increasing distance $||P_j||$ from the origin. For this reason the tree just constructed will be called an exodic tree.

The construction algorithm of the Exodic Tree is shown in Figure 2.



EXODIC TREE ALGORITHM
FIGURE 2

The cost of an exodic tree is

$$\sum_{i=2}^n \min_{j < i} ||P_i - P_j||$$

A formula which is simpler, for analytical purposes, than the cost (or weight) of the MST. Of all trees in which paths from P_j to P_i proceed through points P_j of increasing $||P_j||$ the exodic tree has least cost. Thus there is reason to hope that the cost of the exodic tree, is only slightly more than the cost of the minimal tree.

Prim (PRIM 57) constructed the MST between Washington D.C. and the 48 state capitals (1957). As it is observed in Figures 3 and 4 when the same cities are connected by an exodic tree centered on Topeka, Kansas, 40 of the 48 lines are the same as in the MST.



48 CAPITALS MST

FIGURE 3



48 CAPITALS ET

FIGURE 4

c) Random Network

A random network is a type of network which connects n points placed at random in a certain defined plane, generally a circle, however it can be of any shape.

The behavior of such networks must always provide a lower bound to the performance achievable with a given number of nodes; furthermore, random placement of network elements has been shown to provide a reasonable guide to the performance of real networks in some cases. (ROSN 76). And in the case of networks with mobile units, the random network provides the only feasible mathematical model of the network.

III. RELATED PROBLEMS AND SOLUTION TECHNIQUES

Unfortunately, a special interest has not been dedicated to the problem of designing Radio or Satellite Networks. However there are several papers which show problems and solution techniques for Packet Radio Networks (FRAN 75) and Mixed Media Networks (Satellite and Terrestrial Links) (HUYN 77), (MCGR 77), (MARU 78), (CHOU 78) (GERL 74) and (TELL 80) Knowing exactly the location of the nodes which belong to the network, and for this reason, we can say that their solutions are focused to "deterministic" networks.

Random Networks provide us the feasible model to analyze the behavior and bounds for mobile units. The properties of Random Networks with respect to a satellite based communications system are examined in (ROSN 76) and (ABRA 75). In both papers it is assumed that the satellite channel operates in a multiple access/broadcast fashion and the cost of this channel is fixed, these approaches optimize the number of earth stations required in a network, with users uniformly but randomly distributed over a pre-defined area, in order to minimize the cost of this network. This cost provides them an upper bound to the cost of a real mixed media network with the same number of nodes.

Let's first introduce the approach taken by ROSNER (ROSN 76).

Let's assume that a fixed area exists in which user locations are uniformly but randomly distributed over the area A as shown in Figure 5. In the paper developed by Rosner it is desired to determine the number of satellite earth stations that will optimize overall network cost. The earth stations act as concentration points and serve

a number of users in their area of influence.

The service area is assumed to be divided into n server areas, each of side a . Each of the n servers is located at the center of one of the square service areas. Therefore, in order to completely cover the service area

$$A = na^2$$

or

$$a = \sqrt{\frac{A}{n}}$$

The objective of the analysis in (ROSN 76) is to minimize the total cost function of the network that can be written as:

$$C = qC_1 \bar{l} + nC_2 + \text{satellite cost} + \text{terrestrial fixed costs}$$

where

q = number of user locations

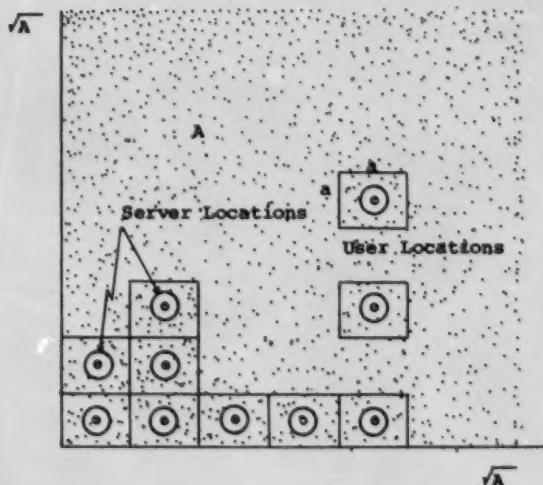
n = number of server locations

C_1 = cost per mile of lines from users to servers

C_2 = cost of a server node (in this case an earth station)

$\bar{l}$ = average distance from users to servers

For our purposes we are just interested in how to determine the parameter $\bar{l}$ and the results obtained for this parameter.

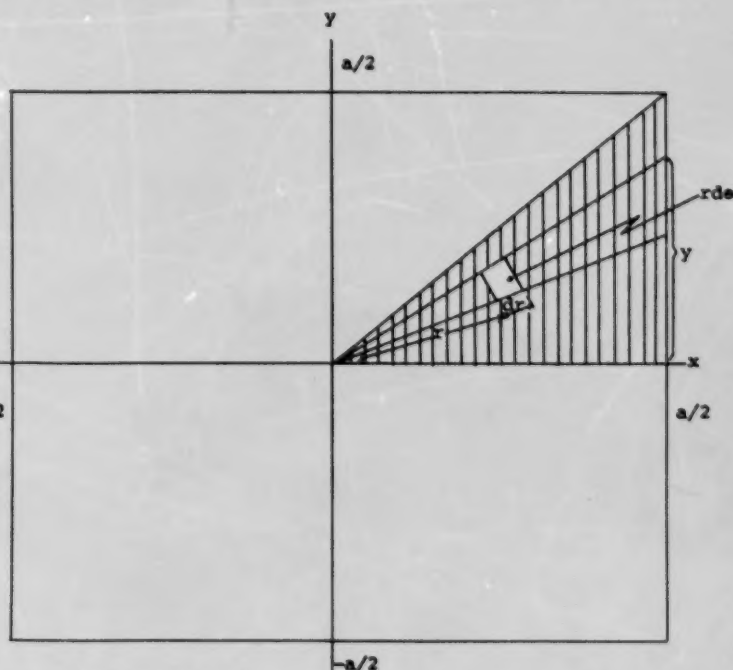


RANDOM USERS-TESSELLATED SERVERS

FIGURE 5

Within each elemental service of side a there will be, on the average, q/n users, since the users are assumed uniformly distributed; at the center of each elemental area is one of the n server nodes, so the parameter $\bar{l}$ represents in this case the average distance from the center of each square service area to each point within the square.

The average distance from the server to each of the user points within the elemental serving area is computed using the geometry of Figure 6. From the symmetry of the problem we can say that the average distance of the points from the center in one-eighth of the square (shaded area in Figure 6) is the same as the average distance for all of the points in the entire square.



GEOMETRY USER FOR AVERAGE DISTANCE CALCULATION. TESSELLATED CASE

FIGURE 6

Then $\bar{l}$ can be formulated as:

$$\bar{l} = \int_0^{\pi/4} \int_0^r \frac{r^2 dr d\theta}{a^2/8} \quad (2)$$

where,

$$\sec \theta = \frac{r}{a/2}$$

thus:

$$\bar{l} = \frac{8}{a^2} \int_0^{\pi/4} \int_0^{\frac{a}{2} \sec \theta} r^2 dr d\theta \quad (3)$$

Integrating with respect to $\bar{l}$ yields:

$$\bar{l} = \frac{8}{3a^2} \int_0^{\pi/4} \frac{a^3}{8} \sec^3 \theta d\theta \quad (4)$$

Integrating with respect to θ yields

$$\bar{l} = 0.381 a \quad (5)$$

using equation (1) in (5)

$$\bar{l} = 0.381 \sqrt{\frac{A}{n}} \quad (6)$$

An analysis that determines $\bar{l}$ for Random Users and Random servers is shown by Abramson in (ABRA 75) and (ABRA 79).

The approach taken by Abramson is as following:

Assume a random network where we can define l_1 as the distance from a given user to the closest server, l_2 as the distance to the second closest server and so on (See Figure 7). Let's define ρ as the density of servers (the average number of servers per unit area).

$$\rho = \frac{n}{A} \quad (7)$$

Assume that the occurrence of servers in nonoverlapping areas in the plane constitute independent events and the probability that a differential-area dA contains a sink is ρdA . Then we can use standard approximation arguments (KEND 63) to show that $p(j : A)$, the probability that the area A contains exactly j servers is Poisson

$$P(j : A) = \frac{(\rho A)^j}{j!} e^{-\rho A} \quad (8)$$

Now if we let the area A be a circle of radius l with a user at its center, we can take a derivative of $P(0 : \pi l^2)$ with respect to l to obtain the density of the distance to the nearest server.

$$p(l_1) = 2\pi l_1 e^{-\pi \rho l_1^2} \quad (9)$$

Thus we have the result that l_1 is Raleigh (TAUB 71) with parameter $1/2\pi\rho$ and mean value $(\sqrt{\pi/2}, \sqrt{1/2\pi\rho})$.

Thus

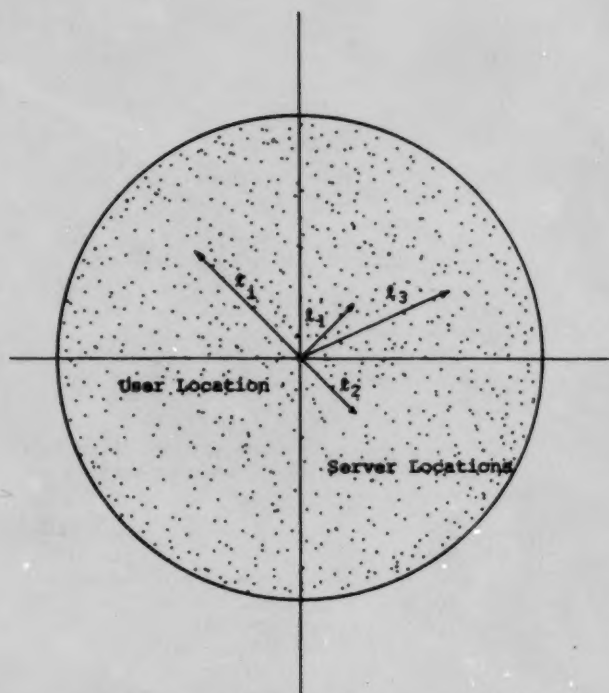
$$\bar{l} = \frac{1}{2\sqrt{\rho}} \quad (10)$$

Using (7) in equation (10) we have that

$$\bar{l} = \frac{1}{2} \sqrt{\frac{A}{n}} \quad (11a)$$

or

$$n = \frac{1}{4} \frac{A}{\bar{l}^2} \quad (11b)$$



NETWORK GEOMETRY-RANDOM USERS, RANDOM SERVERS

FIGURE 7

IV. ANALYSIS AND NUMERICAL RESULTS

As we have observed, the approaches mentioned in the last section optimize the number of servers required in a multiple access/broadcast satellite environment using the random network concept from different points of view, as it is shown in Table 1.

PARAMETERS	(ROSN 76)	(ABRA 79)
Determine $\bar{l}$	Yes	Yes
Geometry	Tesselated	Circle
Fixed Point*	Server	User
Random Points	Users	Servers
Terrestrial Path between user-server	Yes	Yes
Terrestrial Path between Servers	No	No

TABLE 1
SIMILAR PREVIOUS APPROACHES

Considering that every user should be communicated with any other user in certain predefined area, with these approaches we must assume the following:

- 1) A terrestrial path between user ↔ servers
- 2) A communication channel that "illuminates" all the area where the servers are.

This last assumption is very feasible when the communication channel is a satellite channel with multiple access/broadcast properties and the servers are earth stations. However the second assumption is very difficult to find when the servers are radio repeaters and it is necessary to communicate these repeaters by a terrestrial path.

For the last case, we will first determine $\bar{l}$ based on the Random Minimal Trees properties and observations given in a paper by E. Gilbert (GILB 65).

Considering that a fixed geographic area exists in which users and servers but randomly are uniformly distributed over that area, it is easily estimated the number of repeaters for a Random network knowing the Area and the repeater range.

Then, the problem of connecting any user to any other user (out of range from the first), in a restricted area, is to provide a path between them by the repeaters as nodes of this path. It is reasonable to think that for this path, the most successful connection between two users, in a multiple access/broadcast radio channel with repeaters, will be the Minimum Tree between all the trees which can be drawn to interconnect n points (repeaters or users). This is because of the properties that have the Minimum trees (See principles 1 & 2 Section II).

Since the weight of an exodic tree is slightly more than the minimum tree and it is simpler to analyze than the weight of a minimal tree in Random networks, in the paper by E. N. Gilbert (GILB 65) is shown the expected weight of the exodic tree connecting n points placed at random in the unit circle $||P|| \leq 1$.

In the paper mentioned above is considered an exodic tree connecting a random number of points with mean $\bar{n}$ placed in the unit circle by a Poisson process. It is defined $S(\bar{n})$ as the expected length of this random exodic tree. It is shown in Theorem 2 of this paper that: If the unit circle has a continuously turning tangent at every point, then as $\bar{n} \rightarrow \infty$

Lim sup

$$S(\bar{n}) \leq \left(\frac{1}{2} \pi\right)^{1/2} \bar{n}^{1/2} \quad (12)$$

In a work developed by Bearwood, Hammersley and Halton (BEAR 55) it is given a constant multiplied by $(An)^{1/2}$ as an asymptotic formula for the expected Euclidean length of the minimal tree joining n points in a region of area A . Therefore, the length in the unit circle would be asymptotic to a constant multiplied by $(\pi n)^{1/2}$. From equation (12) we can deduce that the constant is less than $\frac{1}{\sqrt{2}}$.

Therefore, in the worst case, we can say that:

$$S(n) = \frac{1}{\sqrt{2}} (An)^{1/2} \quad (13)$$

* For analysis purposes

Considering that: 1) the range of a repeater (server) or a user is the same for all of them; 2) the limit shown in equation (12) is true as $n \rightarrow \infty$ and 3) the repeaters and users are uniformly but randomly distributed over a fixed area A.

We can say that:

$$S(\bar{n}) = \bar{n} \bar{l} \quad (14)$$

Using equation (13) in (14) we have that:

$$\bar{l} = \frac{1}{\sqrt{2}} \sqrt{\frac{A}{\bar{n}}} \quad (15a)$$

or

$$\bar{n} = \frac{1}{2} \frac{A}{\bar{l}^2} \quad (15b)$$

This last equation can be interpreted as following: given a fixed area A and knowing the range of the repeaters and users which are uniform but randomly distributed over the area A, it can be estimated the maximum average number of repeaters required in order to communicate any pair of users, which lay in the area A, by an Random exodic tree. This statement is valid if $A \gg \bar{l}^2$.

As we can observe from equations (11b) and (15b) the $\bar{n}$ here derived is surprisingly the double amount of repeaters required than the number of earth stations derived in (ABRA 79) having a multiple access/broadcast satellite channel.

Applications

The result of this section can be applied to a number of cases in order to show the potential applications.

- 1) If in the USA it is desired to communicate some mobile units which will be distributed all over the country and the range of these mobile units and repeaters required are 50 miles. If USA area = 4×10^6 miles.

The estimated number of repeaters required is:

$$\bar{n} = \frac{1}{2} \frac{(4 \times 10^6)}{(50)^2} = 800 \text{ repeaters}$$

- 2) In Mexico it is necessary to make a decision between using repeaters with a 100 km range and repeaters with 75 km range in order to communicate mobil radios

which are distributed uniformly over this country. The cost of the 100 km range repeater is \$10,000 and the cost of the 75 km range is \$8,500.

If

$$\text{Mexico area} = 2 \times 10^6 \text{ kms}$$

The number of 100 kms repeaters required is:

$$\bar{n} = \frac{1}{2} \frac{(2 \times 10^6)}{(100)^2} = 100$$

and the number of 75 kms repeaters is

$$\bar{n} = \frac{1}{2} \frac{(2 \times 10^6)}{(75)^2} = 178$$

Total cost 100 kms repeaters = 1,000,000
Total cost 75 kms repeaters = 1,513,000

Therefore, it would be better to invest in the 100 kms repeaters.

V. SUMMARY AND CONCLUSIONS

This paper has shown some approaches that address the problem of topology considerations when it is used a radio multiple access/broadcast channel (satellite or terrestrial links) and mobile units. It is interesting to point out that from different approaches which use the random network concept, all of them converge to an equation of the type $n = \text{constant} \times A/\bar{l}^2$.

In the analysis presented in Section IV a special emphasis has been given when the server nodes are repeaters, and the multiple access broadcast channel is a terrestrial radio link when $A \gg \bar{l}^2$. From this point of view the problem can be stated as an application of the limit found in 1965 by E. N. Gilbert presented in (GILB 65) and the result is that maximum average number of repeaters required is $\bar{n} = A/2\bar{l}^2$. However, this formula express the superior limit; a good numerical approximation when $A \gg \bar{l}^2$ according with some experimental results given in (GILB 65) is that $\bar{n} = A/2.19\bar{l}^2$.

In Table 2 we show a comparison of the approaches here described. As we can observe from Table 2 one of the advantages of the approach here analyzed is that it is valid eventhough both the repeaters (servers) and users are mobile units.

PARAMETERS	(ROSN 76)	(ABRA 79)	OPTIMUM RADIO REPEATERS DEN SITY
Determine $\bar{I}$	Yes	Yes	Yes
Geometry	Tesselated	Circle	Circle
Fixed Point*	Server	User	None
Random Points	Users	Servers	Users & Servers
Terrestrial Path between user ↔ server	Yes	Yes	Yes
Terrestrial Path between servers	No	No	No

TABLE 2

COMPARISON APPROACHES USING THE RANDOM
NETWORK CONCEPT

* For analysis purposes

VI. ACKNOWLEDGEMENTS

I would like to thank to Dr. Norman Abramson to whom I am indebted by pointing out the potential importance of reference (GILB 65).

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Telephone Talk and Broadcasting As Related to the Telecommunications Industry

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Interfacing the broadcast studio to the dial-up telephone network is a problem that has plagued the broadcast engineer for decades. Only recently has the telephone industry looked towards the broadcaster and his needs in developing devices suited for this purpose. Techniques by which telephone talk has gotten on the air are discussed with an outlook toward the future.

1. INTRODUCTION

One of the biggest problems over the years is how to couple a telephone with the other equipment in the broadcast station. Telephone coupler design, from the inexpensive home-brew variety to those made commercially, requires knowledge of the telephone line impedances, in order to design a balance network to maximize trans-hybrid loss.

In a telephone talk station, the telephone is as important as a turntable is to a music station. In designing the system employed at WOR Radio in New York City⁽¹⁾, we carefully measured line impedances from the station terminal room to the main distribution frame in the central office. Drastically different impedances between exchanges and substantial differences from call to call on the same line were encountered.

It is the purpose of this paper to show measurements of line impedance and the development of telephone to broadcast station interface from the beginning to the present.

2. LINE IMPEDANCE MEASUREMENT

The required measurements are easy to make requiring little judgment by the measurer helping to maximize accuracy. Figure 1 shows the test setup which includes two sampling points to check whether the impedance is capacitive or inductive.

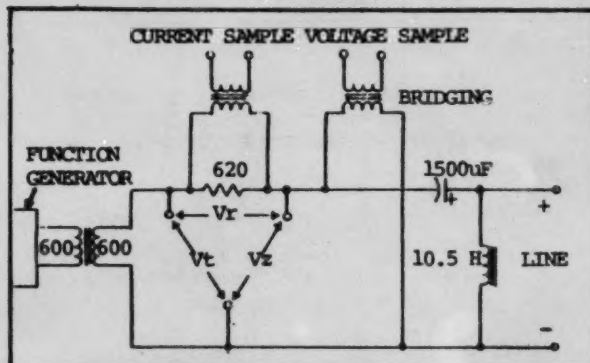


FIGURE 1. Test setup as used in the line impedance measurements.

Since the impedance to be measured is to be under actual calling conditions, the line must be held off hook. The components, shown in Figure 1, have negligible effect on the measurements taken due to their reactance characteristics at the frequencies in test. The 10.5 H coil has a low enough resistance to hold the line off-hook, but has a minimum reactance of 13000 ohms at 200 Hz. The 1500μF capacitor has a maximum reactance of 0.5 ohms at that frequency.

Measurements were made at standard 1/3 octave frequencies between 200 and 500 Hz. Table 1 shows the equations used to find the impedance.

$$V_r = \frac{(V_t)^2 - (V_z)^2 - (V_z)^2}{2V_r}$$

$$V_x = \frac{(V_z)^2 - (V_r)^2}{2V_r}$$

$$I = \frac{V_r}{r}$$

$$Z = \frac{V_x}{I}$$

$$\theta = \tan^{-1} (V_x/V_r)$$

$$r = \frac{V_r}{I}$$

$$x = \frac{V_x}{I}$$

where V_t, V_r, V_z = measured voltages in figure 1

V_r = voltage across r

V_x = voltage across x

I = current through r

Z = magnitude of unknown impedance

θ = phase angle of unknown impedance

r = resistance of unknown impedance

x = reactance of unknown impedance

TABLE 1. Equations used to calculate impedances.

3. RESULTS OF IMPEDANCE MEASUREMENTS

The measurements were averaged at each frequency over all exchanges and all calls. The results, shown in Figure 2, are the averages of all the measurements. The ± 1 standard deviation range at 200 Hz goes from 450 to 1720 ohms!

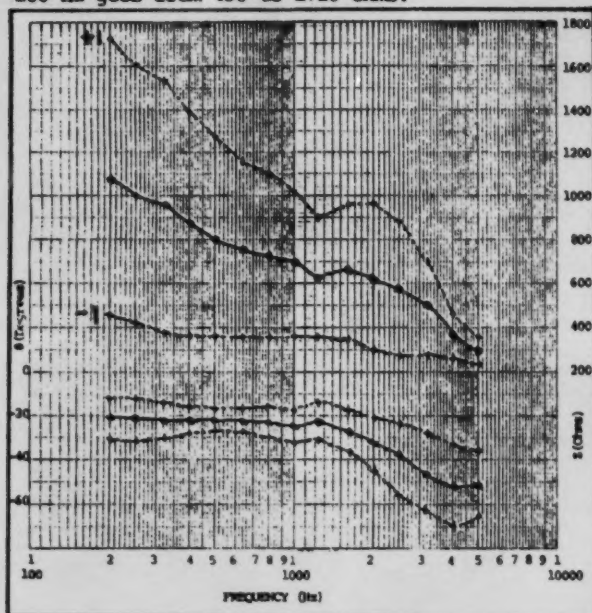


FIGURE 2 Averages of all telephone line impedance measurements.

4. METHODS OF INTERFACE

In a send or receive only situation, the standard 30A Voice Coupler shown in Figure 3 can be used.

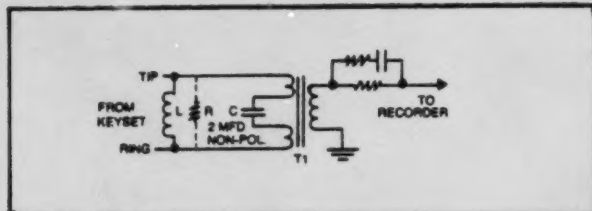


FIGURE 3. Type 30A Voice Coupler

In Figure 4, we see the typical transformer coupled hybrid. Studio feed to the phone line appears at 1/2. Telephone two-wire connection at 3/4. External balance network can be added at 7/8; with the telephone audio feed to the console appearing on 5/6.

In the real world, as shown earlier in Figure 2, the telephone line displays a highly complex reactance which changes from line to line and depends on circuit conditioning, loop length and impedance of the calling party's telephone line.

A perfectly complementary balance network is almost impossible to realize and then it is only valid on that particular circuit. I found that a null of 15 to 25 db can be achieved with a deeper null achievable by modifying four-wire termination sets commercially available.

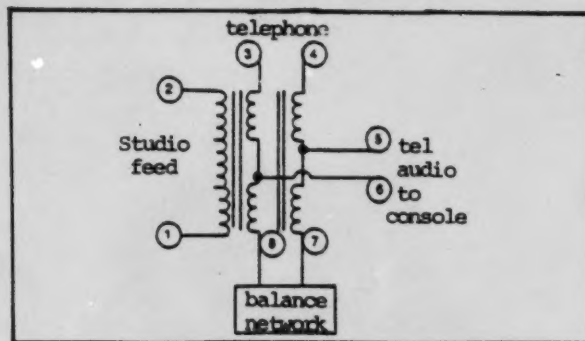


FIGURE 4. Transformer coupled hybrid.

The mix-minus approach (mixing everything that appears on the broadcast console; except the telephone feed and sending these sources back out to the incoming caller) has proved to be very effective and also serves as a feedback reducer. Figure 5 shows the typical mix-minus circuit.

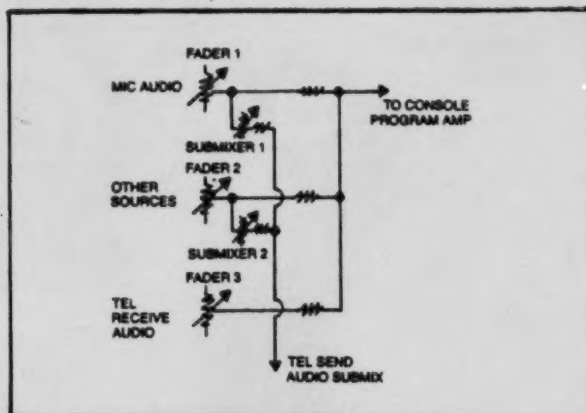


FIGURE 5. The Mix-Minus Circuit.

Using band limiting and noise gating circuitry, hybrid leakage and compressor gain changes do not adversely affect the quality of the on-air telephone call⁽²⁾.

5. CONCLUSION

In this paper I have presented several currently used techniques employed in interfacing the dial network with the broadcast facility.

Although the telephone has existed for over a century and commercial broadcasting has entered its seventh decade, there is still a need for improvement in the interplay of these two divisions of the

telecommunications industry.

We can only hope that some of the new interfaces that have been or are about to be introduced commercially will solve some of these problems.

6. NOTES

(1) WOR Radio and the RKO Radio Networks' telephone facility in New York was designed, fabricated and installed by John M Lyons and Herbert E. Squire, Jr. WOR/1978; RKO 1980.

(2) A telephone mix-minus module designed and developed for the Pacific Recorders and Engineering Corporation's BMK series II consoles by John M Lyons and Jack Williams, President of PR&E, 1980.

Telecommunications in a Pacific Archipelago:
The Fiji Islands

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1. Abstract

This paper sets out the various types of telecommunication services in use in a South Pacific country and some of the problems which are peculiar to the situation in a scattered, developing island community.

2. TELECOMMUNICATION SERVICES IN FIJI

There are about 300 islands in the Fiji archipelago covering an area of approximately 300,000 square kilometres and with a population of 600,000 composed of two main ethnic groups, the indigeneous Fijians and the Fiji-Indians together with many small ethnic groups. There are three languages in everyday use, English, Fijian and Hindi. The telecommunication needs are supplied in a number of ways and reflect the types of systems found in a much larger and more populous country.

2.2 BROADCASTING

Fiji is covered by a medium-wave broadcasting system financed partly by Government and partly from advertising. Studios in the capital Suva produce two simultaneous programs and these are broadcast from several high power stations situated in strategic locations and operating on different frequencies. The two programs cater for the different language groups. In Suva a VHF-FM station provides a largely English service and offers a stereo service on a part time basis. Experimental regional programmes have been started recently. The broadcasting network as well as providing entertainment and news is also the means of communicating weather warnings, particularly hurricane alerts when necessary. There is no television service as the Fiji Government believes that basic facilities such as water supplies and electric power in rural areas should take priority in government planning. At the latest estimate there were said to be at least 5,000 video tape recorders in use in private homes.

2.3 TELEPHONE AND TELEGRAPH SERVICES

The country is completely serviced by a telephone system, different types of service being used to cater for various traffic densities. The main centres of population are linked by multi-channel micro-wave chains, the more populous small islands and communities are able to connect into the normal automatic system by VHF radio telephone, small isolated communities are equipped with simplex HF radio telephone and must be connected manually to the main system. Almost all towns now have automatic exchanges and are interconnected through micro-wave or carrier links. In conjunction with the telephone service there are telegraph and

2.3

telex facilities and a few subscribers such as airlines have data links. The telephone system connects with the international satellite and cable systems but overseas subscriber dialling facilities are not available.

2.4

Overseas shipping works into the Suva marine radio station JDP which operates a typical service for ships at sea. All local commercial craft must be radio-equipped and work into a separate network which also handles some of the HF telephone and telegraph traffic from isolated communities.

2.5

All international flights through Fiji airspace are controlled and covered by the various facilities at Nadi International Airport. There are point to point links with all the surrounding Pacific territories using HF radio, contact with aircraft is by HF and VHF radio. Navigational aids at Nadi include radar, DME, VOR, and an instrument landing system.

Local flights and local airports are largely controlled from the Suva airport at Nausori; flight control is by VHF but smaller airports are not equipped for contact with aircraft. There are numerous LF direction finding beacons scattered throughout the country and Nausori has DME and VOR. Nausori receives overseas flights but is not classified as an international airport. The main weather station is at Nadi Airport and is equipped to receive satellite weather pictures from the CMS Japanese weather satellite. It also has an emergency HF link with weather observers throughout the country but normally weather observations are sent through normal telephone channels.

2.6 MILITARY AND NAVAL

Fiji has permanent naval and military units. These are equipped in the usual ways for communications between units using both the HF and VHF bands. The army has a permanent link between the Suva barracks and its units serving with the Unifil peace keeping force in Lebanon. A similar link will probably be established

between Fiji and its units which will serve with the international observer force in Sinai.

2.7 POLICE

For security reasons the police force maintains its own communication links by HF and VHF radio between its various posts and also with mobile units. At times handy-talkies are used for traffic control and security.

2.8 MOBILE SERVICE

There is an increasing use of mobile facilities, as well as police ambulance and fire services many commercial enterprises are using mobile units mainly in the 70 MHz band. Taxis, cleaning services exploration, mining and construction enterprises, repair services are all finding this a most useful means of communication and fuel saving. Some government vehicles, particularly ministerial cars are equipped with mobile facilities which permit dialling into the telephone service. The main hospital in Suva uses a UHF paging service for medical staff on call.

2.9 USPNET AND PEACESAT SATELLITE SERVICES

Since 1972 the University of the South Pacific has been involved in the PEACESAT and later the USPNET satellite service. This has been an exciting and useful experiment linking Fiji with other countries in the Pacific region in teaching and conferencing situations. The satellite service has provided valuable links in various emergencies such as the cholera outbreak in Kiribati and the Pacific-wide dengue epidemics of the late 1970's.

2.10 AMATEUR RADIO SERVICE

There is a small number of local amateur operators, these operate in the HF, 50 MHz and 146 MHz amateur bands. Regular meetings are held and a training program is in operation. The local amateur association operates the JOTA station for the Fiji Scout movement each year.

2.11 CB

There is some official CB use in Fiji by private individuals. The Royal Suva Yacht Club operates a limited service using one channel for craft in and around Suva. Only two channels are available officially and CB activity is licensed.

2.12 TRAINING

Earlier this year (1981) a regional telecommunications training complex was opened in Suva, this project was funded by the European Economic Community and will train personnel from the South Pacific region involved in various aspects of telecommunications.

2.13 CABLE AND COMMERCIAL SATELLITES

Fiji is linked to the international community via the Compac cable and through the Pacific intelsat. A local company, FINTEL now operates the Fiji earth station and cable complex. A cable repair ship is permanently based in Suva. HF links are still used between some Pacific islands not equipped with earth stations.

3. PROBLEMS IN A SCATTERED ISLAND COMMUNITY

As can be seen from the foregoing, the telecommunication services which exist in Fiji are similar to those found in a much more complex community and the equipment is often of the same kind installed in much larger communities. There are a number of problems which arise, some are set out below.

3.2

Because of low density of population, particularly in the outermost islands, transport is infrequent and irregular. Maintenance teams visiting these stations spend a high proportion of their time travelling, this is uneconomic. If equipment is sent to a central maintenance base the time it is out of service can be very great, if a breakdown occurs the community may be isolated for several weeks.

3.3

The large variety of equipment in use places a severe strain on maintenance personnel who must acquire servicing skills in many fields, this usually results in excessive time out for maintenance and repairs.

3.4

The effect of the maritime environment and the high ambient humidity and temperature increases the maintenance problem. Many stations are close to the sea and fringing reef and equipment quickly becomes affected by the salt and moisture; modern ICs are just as prone to failure from this cause as earlier components were. An average rainfall of 3 metres per year and the occasional hurricane add to the environmental hazards.

3.5

Air-conditioning may be thought of as a solution to the last problem but in many situations is not viable. The cost of transporting fuel to isolated communities is very high and to keep a station servicing a small number of people economic, the fuel used must be kept at a minimum, this rules out the use of air-conditioning. With air-conditioning there is also the hazard that if it is switched off to save fuel condensation occurs

causing damage to equipment.

3.6

There are other problems which have not been mentioned but one last one must be mentioned. The continual advance in electronic technology is a very great difficulty to a small developing country. Every few years the old systems are replaced by more up to date ones and when this occurs the local engineers and technicians are immediately at a disadvantage. When new equipment is introduced expatriate staff are often needed during the settling in period, this is not good for the psychology of the local staff and when they finally begin to master all the difficulties posed by newer equipment the process is likely to begin again. Three examples come to mind, the change over from the older type of automatic telephone exchange to the new cross-bar type, the introduction of SSB units for simplex radio telephone to replace the older AM units and also the installation of multi-channel micro-wave links to replace the VHF radio telephones. Often the change over does not have to be examined very carefully from an economic point of view because the newer systems are supported by foreign aid. This raises a very large issue which is beyond the scope of this paper but the question still arises, does Aid aid?

4. APPENDIX

VARIOUS TYPES OF RADIO STATION LICENCES ISSUED BY P & T	
TYPE OF STATION	NUMBER OF STATIONS
Aeronautical stations (HF)	15
Aeronautical stations (VHF)	11
Aircraft stations	34
Amateur stations	29
Broadcasting stations	7
Citizen's band stations	228
Earth station	1
Fixed & mobile land stations (HF)	35
Meteorological stations	14
Navigational aids (Aer)	20
Private coast station	9
Radio linked microphone stations	2
Radiophone station (VHF)	250
Radio telemetering stations	11
RF paging station	1
Ship stations	158
VHF Land mobile stations	751

Basic
Telecommunications
Services:
Business and User
Applications

Worldwide Telecommunications
Management and Planning Issues

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1. Abstract

It has often been claimed that in the past two decades communications technology has become one of the main, if not the main igniting force of our social revolution. If one accepts this as a fact, and then adds to it the anticipated technological innovations and breakthroughs of the next two decades, we have amply justified reasons to be seriously concerned with the effect that our handling of telecommunications management and planning issues will have in the future of our society.

We are neither psychic forecasters or brave enough to challenge the abnormal behaviour, and unpredictable capabilities, of today's technology or technological institutions. Hence, what we will be discussing in this paper is not to be considered a firm technological forecast for the next two decades, but rather our humble opinion of what could, and may very well happen during that period.

Naturally, we are guided by our continuous study of technology trends, the developments of the last few decades, and the social and economic pressures which the scientific and technological sectors have brought upon themselves. Such a complex environment is not easy to manage, and experience has shown that educated long-range planning is at best a very difficult task. Hence, we shall confine our opinions to the management and planning issues in our "Information Society".

2. PLANNING

A few years ago, while addressing a conference, we said that the three most important tasks of a telecommunications manager are Planning, Planning and more Planning. Planning, as we visualize it, goes across the full spectrum of a manager's job, i.e. planning for Staff, Organization, Networks, Services, and "Corporate Receptivity". A common problem in the past was that few Telecommunications Departments had a planning function, as such. Also, most of the time whenever any planning was done, it was a task-force type of effort; that is, planning was done for a given project, and then executed; but no more planning was deemed necessary. This was, and still is, the biggest fallacy. Planning must be an on-going effort if it is to be effective.

3. CONSULTANTS vs. STAFF

A strong consideration in staff planning should be the usage of consultants. When, who, and how to use consultants is just as important a decision for the telecommunications manager as that of who, when, and how individuals should be hired for permanent staff. In fact, most of the successful telecommunications managers are those who have planned and used a proper balance of staff and consultants.

Let us take a look at staffing first. There are two basic sources of personnel - internal and external. We ought to be careful with internal sources, to be sure that we get what we need, not what someone gives us. In external sources we can recruit through our own personnel departments, direct efforts, or the recruiting agencies. We must determine exactly what kind of individual is needed before recruiting starts. Certainly, the type and size of staff we hire must relate to the specific size and characteristics of the function and the corporate telecommunications needs. Most importantly, a continuous education program must be implemented to assure the professionalism of all staff. Also, it is here that we should plan to what extent we will use staff or consultants. Much too often we hear the question "Why consultants?". We say much too often because the answer to that question is very simple, "The wise, planned, and well managed usage of consulting services can be, and invariably is, the most economical and expeditious way of managing corporate telecommunications". To be sure, though, selecting the consultant is an important and serious task.

4. ORGANIZATION

The way a telecommunications function should be organized depends, of course, on many things. Overall corporate structure, corporate management philosophy, the relationship of Data Processing and information flow, and Telecommunications functions, the physical locations of personnel and qualifications of staff, are all factors of paramount influence in any organizational structure. However, organization is a very serious subject. Hence, we must evaluate any and all hypothetical cases, alternatives and opinions. Then, draw the conclusions that appear to provide the smoothest flow of management and productivity, at the lowest possible cost.

5. NETWORKS

There was a time when implementing an international single circuit or a worldwide network was a straightforward matter. To be sure, it was not an easy or simple matter, but it was straightforward. The reason for that was, that we could approach our domestic communications organization or one of International Record Carriers (IRC's), depending on the origin and destination of our circuits, and tell them what service we needed. They would then "tell us" how they were going to do it, when, and for how much. This meant that they dealt with the foreign administrations for the overseas terminations of our circuits. In a sense, the IRC's and the domestic and foreign PT&T's formed a very closely kept cartel which dictated what services we would get and we had very little to say about it. Also, overseas we rarely could get services beyond the Gateway Cities, or had any choice of equipment or routes, for our international services. Likewise, to get domestic services for our business facilities in foreign lands was a straight matter, i.e., we told them what we needed and then they told us what we would get, at their own terms, and that was it.

There was one international organization, the "International Telecommunications Union", which established and monitored the Standard Recommendations for Worldwide Communications. Most countries were members of this organization and followed their recommendations. The United States, within its domestic networks, was one of the few exceptions. In the entire world there were but few manufacturers of telecommunications equipment, and even fewer of them that marketed their products internationally.

For the few of us insane enough to be International Communications Consultants, or the even fewer Corporate Telecom Managers, this "simple, forward matter" was a nightmare. The Planning and

Implementation of International Networks was mostly dedicated to business-social-political matters. And yet, we had to be strong technologists to be accepted or listened to by most communications agencies throughout the world.

Let us now take a giant leap from then to today's Information Society. What a dream world it is! It can still be a nightmare, but now only for those that "do not plan" properly. With proper planning the opportunities are almost unlimited. We can now plan for corporate or public communications as a business resource, a profit generator rather than an expense. Let us not become over-enthusiastic though. Because it is no longer a "straightforward matter"; it has become a very complex, intricate and serious matter, instead. The following thoughts serve to illustrate today's complexity and seriousness of this matter:

a) Freedom of choice is a burden as much as it is a privilege. Today, we have the choice of services such as Voice, Data, Text, Video and Image; then Word Processing, Teleconferencing, Timesharing, Videotex, On-Line Systems, etc. There are many disciplines that form a fully integrated network. Worldwide, for each discipline, there are ten to eighty-one manufacturers. Furthermore, we have International Carriers, Domestic Carriers, Common Carriers, Specialized Carriers, Value Added Networks, Foreign Carriers, Foreign PTT's, Foreign Private Domestic Carriers, etc.

b) Regulation is an impairment as much as it is protection. Worse still, it is an ideal vehicle for political "undertakings". The number of official and quasi-official agencies and groups that issue and control, or influence the issuance and control of Communications Regulations worldwide is purely incredible; and this uncontrolled web keeps on growing.

In the international scenario we have also the International Telecom Union, European Post and Telecom Conference, Organization for Economic Cooperation & Development, European Economic Communities Parliamentary, Council of Europe, Intergovernmental Bureau of Informatics, United Nations (UNESCO, UNCTAD, etc.), Pacific Telecommunications Council, etc.

c) In the past, good foreign policy was usually good only for "someone". Hence, a wave of protectionism, nationalism, trade barriers, technical barriers, air rights, water rights, personal privacy, etc. which really started about twenty years ago has now developed into a full size uncontrollable gigantic evolution. Because communications is a vital and integral part of any successfully growing or established society, we find ourselves right in

the middle of this socio-political-economic turmoil.

Anyone who has ever done Strategic Business Planning for a corporation or a public agency knows how difficult and serious task it is. Naturally, those who have done so for multi-national corporations know how much more complex and unpredictable the task becomes. Well, in the world of Strategic Planning for Worldwide Communications Networks, the very same complexity and unpredictability takes place. Just as in the business side, it takes lots of talent, very versatile personnel, a continuously updated knowledge of the technological, business and socio-political environments, and substantial amounts of manpower.

Strategic Planning for Corporate Worldwide Communications Networks must begin with the proper Corporate Planning. In other words, it must be part of the total Corporate Business Plan. It is really very simple; if today any corporation CANNOT function without electronic communications and equipment, how can we plan our business without considering one of the vital tools without which the business plan cannot be implemented? Also, please let us keep in mind that this first step of corporate planning must include plans for proper staffing (with employees, consultants, contractors etc.), proper training, and a formidable determination for continuous education and planning. Only then can we start thinking about International Communications or Telecommunications Planning.

6. SERVICES

Dealing properly with the vendors (manufacturers, PTT's, agencies, consultants, IRC's, etc.) is another element of paramount importance to the management of any telecommunications organization. Firstly, of course, is the purchaser-vendor relationship which went into consideration when we planned our organization. Then, there is the process via which we get from them the information, prices, proposals, implementation and services that are required to allow us to plan and operate efficiently and profitably. Although there are many routine matters handled between ourselves and our vendors, let us dramatize some key factors of this purchaser-vendor relationship.

We must obtain information about either specific equipment, services and capabilities, or about the vendors total qualifications in a given discipline. Now, with this information and our plans for the project, our staff, or staff and consultants, will work on the selection of equipment and services, design and engineering. Then, it is time to go out and get firm prices on both equipment and services, plus delivery information.

We can now complete our planning, design and engineering, and get firm bids. Once it is all done, the selection of vendors is made. Now, we sell our recommendations to management and, upon approval, begin contracting negotiations which can be very tedious, time-consuming and frustrating.

Likewise, the implementation of the project is a job that should not be taken lightly. Someone must be assigned as Project Manager, and should be the sole liaison between the corporation and the vendors during the entire project. Likewise, we must demand that the vendors assign someone as their Project Manager with the same liaison responsibility.

During our entire relationship with the vendors, we must remember that, just like our own organization, they are in business to make a profit. Therefore, we must be fair, do not make unreasonable demands and be understanding of any weakness and problems. A vendor who feels respected and handled fairly will always be a much better provider of the services we need.

7. RECEPTIVITY

Perhaps the most common question within the Corporate Telecommunications organizations is "How do we sell ourselves and our programs to Executive Management?". Naturally, we would be less than candid if we did not admit that selling ourselves to Management is a serious and difficult problem. Of course, it is not a unique and exclusive problem of Telecommunications Managers; for as long as the business world has existed, function and department managers have always faced the necessity of selling themselves to top management. However, ours becomes a unique management problem, aggravated and psychologically complex, due to a new added dimension which results from our being an industry within an industry. For example, in a banking corporation, we are not a banking manager, who knows the absolute ins and outs of the banking business, trying to sell himself to a banking Executive who likewise knows the ins and outs of banking business. Rather, we are a telecommunications manager who knows, or most assuredly should know, enough about the banking business to support and service it professionally and profitably, selling our programs to a Banking Executive who knows the banking business, but does not know ours and therefore automatically assumes we do not know his either.

There are no easy solutions to this problem. But, there are some approaches to the problem that may bring about satisfactory solutions. For instance, in reacting to the lack of support we get from top management we cannot just be critical, we must try to understand the reasons, the background, the historical development of this relationship, and the intrinsic philosophy of the business itself. We must have properly planned our organization as a solid, cohesive and profitable unit, plan our programs thoroughly, and prepare our recommendations in business terms, before approaching top management for their approval. Even then, of course, there is no assurance that we overcome the handicap of one industry within another, but most assuredly, our chances of success are very high.

But, in the final analysis, what is important, immeasurably more important, is the fact that if we have planned our operations professionally and profitably, and have carefully and methodically planned all of our activities, programs and recommendations, and have learned to communicate with the business executive in the terms and language that he understands, we will be selling our programs with the conviction and the pride that we have done the best professional job that could be done. This, we submit, is the real success we want to reach: professional integrity, human understanding, and the satisfaction of a job well done.

Alaska and Alascom:
A Decade of Telecommunication Development

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ABSTRACT

Prior to 1971 public telecommunications in Alaska was provided via excess capacity in a military system designed primarily for defense requirements. This paper presents an overview of a decade of Alaskan telecommunication development, by a privately-owned corporation, in a diverse and challenging environment.

I. INTRODUCTION

An American author, Joe McGinniss, travelled extensively in Alaska in 1980. When he decided to set out his experiences in a non-fiction novel, he chose to title his work Going to Extremes. The word "extremes" is a particularly apropos description of virtually every facet - geographic, climatic, economic, and social - of the State and people of Alaska. It is, at once, the northernmost, westernmost and easternmost state of the United States. It is the largest in size, being more than twice as big as the next largest state, Texas. It has the lowest population density of any state, a mere .7 persons per square mile. It contains within its boundaries three distinct mountain ranges, including the highest peak on the North American continent. Seasonal temperature variation for the interior of the State can typically amount to 160° Fahrenheit, from 90° above in the summer to 70° below in the winter. It has the fewest miles of paved highway in the United States. At Barrow, there is no night for 84 days during the summer; during 67 "days" of the winter, there is no day. On any statistically derived bell-shaped curve, one will invariably find Alaska, not in the median bounds, but at one extreme or the other.

The provision of telecommunications services to such a land is, like that land, a unique story, one that is largely synonymous with the history of Alascom, Inc., the state's long-lines carrier. Alascom today operates a system composed of 158 earth stations of multiple sizes and capabilities located throughout the State, which interconnect the national and international toll telephone network to every village of twenty-five or more residents in the State. This system provides or is capable of providing voice and data services to all these locations by virtue of an unparalleled use of satellite technology. Seventy percent of all basic telecommunications services provided by Alascom in and to the State are carried by satellite, at a level of technical proficiency meeting or exceeding Bell system standards for public switched voice networks. Two channels of television -- one entertainment, the other instructional -- are provided to 110

remote villages via Alascom facilities. Dual channel video per transponder is used for urban network video distribution and video conferencing. Advanced private line networks are becoming a part of Alascom's way of life. A Time Division Multiple Access (TDMA) System will link a major oil company's facilities in Alaska with several locations in the "Lower 48". Packet and circuit switched data networks are being implemented and electronic mail distribution, using deployed printer concepts, is expected to be in service this year.

Growth in services and volume has been such as to warrant, and Alascom has recently proposed to the Federal Communications Commission, ownership of a complete satellite, devoted to meeting the requirements of Alascom's customers.

Virtually none of these services or facilities existed a mere ten years ago when, on January 10, 1971, Alascom commenced the private operation of long-lines telecommunications in the State.

The development of this system and of the services provided over it presents a textbook study of how a non-governmental, privately-owned corporation can adapt and apply scientific advances to the business and economic development of basic telecommunications services, even under the most extreme circumstances.

II. ALASKA TELECOMMUNICATIONS IN THE 60's:
STARTING FROM SCRATCH.

Alaska in the 1960's was, as the State's motto recited, truly "the last frontier". The political growth of the state had been slow; although ceded by Russia in 1867, Alaska did not become a state until 1959, the next to last state (before Hawaii) to be admitted. Its economic condition, particularly in the remote or "bush" areas, was on a par with its political development. As one report noted:

By almost every definition in the language of international economics, rural Alaska is an undeveloped area, and were it not part of the United

States, it could qualify for assistance from the World Bank or our own Agency for International Development. Abrams, Charles, Housing the Alaska Native, Anchorage (February 1967) (Alaska State Housing Authority Remote Housing Report No. 1).

Telecommunications were, likewise, in an underdeveloped state. Indeed, they might have been non-existent, but for the military requirements occasioned by the strategic position Alaska occupied in the 1950's and early 1960's. The geographic proximity of Alaska to the Soviet Union over polar routes offered the potential for advance warning of hostile acts, occasioning the construction of such military shields as the Ballistic Missile Early Warning System and Distant Early Warning lines. An integral part of that early warning system and the general military presence in Alaska was the requirement for communications between Alaska and the Lower 48 states. This need was addressed in part by the Alaska Communications System (ACS), a system composed of microwave and cable links constructed and controlled by the U.S. Air Force. In the course of developing and operating the ACS over this early period, the government undertook to make available to the civilian populace of Alaska excess or redundant capacity on its long-lines systems when not required to meet then-present military requirements. The high cost of construction and operation of an equivalent civilian long-lines system, coupled with the low population density (i.e., small potential customer market) provided no incentive for private enterprise entry into the State market for such services. Thus in the 1960's, basic commercial long-lines communications services - message toll and private line - were incidental to and, necessarily, afterthoughts of the government-owned and operated system.

The technology of the ACS reflected the military origins of the system and the proven engineering practices at the time of construction. Cable or line-of-sight microwave links connected the major population centers of Anchorage and Fairbanks to an extended terrestrial system leased from Canadian companies between the borders of Alaska and the border of Montana. Civilian communications, when permitted on the system, were back hauled to Seattle for switching into the domestic toll network by the American Telephone and Telegraph Company. Where costs of microwave or cable construction, because of terrain and climate, exceeded even the government's financial resources, supplementary systems, such as the White Alice Communications System (WACS) existed to connect specific locations of consequence to the armed forces located elsewhere in the State. The technology employed most frequently was that of tropospheric scatter propagation, a technology developed in the early 1950's and of substantial limitations in terms of its reliability and quality. Locations not in

themselves significant in the military scheme of things or not on the telecommunications path to and from militarily significant points received, by and large, no service at all, except as might be available from individually owned, high frequency radios. The most basic of basic services, such as direct distance dialing (DDD), inaugurated in the Lower 48 in the early 1950's, was unavailable to anyone in Alaska in 1971.

The Alaskan populace, though small, proved vocal on the subject of unsatisfactory telecommunications service. Political pressure developed in the 1960's favoring the transfer and operation of the ACS Commercial System into private, non-governmental hands, where civilian requirements would cease being secondary to military ones. In 1968, federal legislation passed which authorized the sale of the ACS by competitive bid to interested private parties. Unlike typical government competitive bids, however, the competition for the ACS focused not upon price, which was essentially fixed, but upon the range of service improvements and offerings and rate reductions proposed by the bidder. Alascom's first parent company, RCA Global Communications, won the competition; following the negotiation and execution of a contract of sale, ownership and operational control of the ACS passed to Alascom in January, 1971, for the sum of approximately \$32 million.

It is worth noting, from the perspective of the closing decade of the 1960's, the modest expectations which the interested parties to the ACS sale held for Alaskan telecommunications and, by inference, for Alaska itself. Alascom had contractually committed itself to the following undertakings:

Provide basic service to 142 remote or "bush" locations

Explore the feasibility of providing satellite service for up to 49 locations in Alaska

Spend slightly more than \$28 million on future capital investment for telecommunications development in Alaska.

Service via satellite was an experimental concept to be explored for possible use in a relatively few locations. Service to the majority of locations would rely principally on microwave, possibly in conjunction with some satellite technology, the whole likely to require less than an additional \$30 million.

For the Alaska of 1968, with a population of 280,000 and 82,000 telephones, it might have been enough. Against such a modest historical backdrop, modest expectations were appropriate. History, however, does not always repeat itself, and the Alaska of the 1970's was to bear no relation to that of the 1960's.

III. ALASKAN TELECOMMUNICATIONS IN THE 70'S: OVERTAKING THE FUTURE.

In 1971 Alascom inherited a telecommunication system which, by any objective standard, lagged two decades behind contemporaneous systems in the rest of the nation. This condition found reflection in the contractual provisions of the ACS sale and of ancillary agreements for other segments of the military system, which provisions obligated the Company not merely to expand, but in many circumstances, to retire existing system components and replace them with altogether new equipment and system designs. For Alascom, the initial goal of the early 1970's was to try to bring Alaska's basic telecommunications to a state of parity, in technology and quality of service, with those generally prevalent elsewhere in the country at the close of the 1960's.

Toward that end, Alascom embarked upon a major construction program designed to meet those standards. Major reorganization to the switching network was undertaken. Class IV switches were added to Anchorage, Fairbanks, and Juneau toll centers. Stored programming technology was installed to bring DDD to Anchorage in 1972 and the rest of Alaska in 1975.

The course of these changes, however, was itself to be changed by events occurring at both the state and federal level with direct consequences for the social, political, and economic structure of the State. Large oil reserves at Prudhoe Bay on the North Slope of Alaska were confirmed in 1968 and rights thereto were auctioned off by the State in 1969 for the then unprecedented sum of \$900 million. In 1973, Congressional approval was received for construction of the TransAlaska Pipeline System, one of the preeminent technological marvels of this century. The economic ripple effect of the oil discoveries and pipeline construction stimulated business activity to unforeseen levels; the job opportunities created thereby caused dramatic increases in the relatively small population base. These new businesses and their new resident employees, created substantially increased demands for and burdens upon the telecommunications networks in Alaska.

Moreover, the pipeline itself required multiple innovative communications systems. A Blockvalve (BVS) or Remote Gatevalve System (RGVS) was required to continuously monitor the line and to permit instantaneous closure of the pipeline at one or all of 63 points along the line, to minimize the danger of oil spillage upon the fragile tundra. A Backbone Communications System (BCS) was developed to provide end-to-end microwave channels upon which carriage of both pipeline company and general public message communications could occur, to or from any site upon the line. As a further protective system, four earth stations were placed at strategic points along the line to create a satellite-based Alternate Route Communications System (ARCS) which served as an

alternative system to the terrestrial microwave system of the BCS. Each system required capital resources and engineering skills of Alascom over and above those foreseen at the beginning of the decade, in addition to those required for the simultaneous upgrading and expansion of the intra and interstate message network which had been the first task at hand.

Of equivalent impact to the pipeline was the social reassertion and involvement of the native peoples of Alaska. After years of effort, native Alaskans secured passage in Congress of the Alaska Native Claims Settlement Act. This Act created twelve native corporations in Alaska and granted to them, collectively and sequentially, sums amounting to almost \$1 billion and land totalling 44 million acres. No longer relegated to political and economic, as well as geographic isolation, Alaskan natives found themselves shareholders in major corporations with multimillion dollar economic potential in the form of cash and natural resource holdings. As they joined a mainstream of Alaska life beginning to accelerate as a result of oil development, their demands for telecommunications services grew in response to the growth of their economic and political involvement in the State. These demands, like those of the pipeline and its related activity, required further commitments of capital and human resources in support of telecommunications activity beyond those foreseen at the end of the earlier decade.

On the federal level, equally significant events transpired. In 1972, the FCC concluded, in Docket 16495, that the age of commercial domestic satellite facilities had arrived and began to issue authorizations to qualified applicants. Alascom, as a subsidiary company in the RCA domestic satellite effort, was part of the first operational domestic satellite facility in the United States, commencing service to Alaska over the Anik II satellite in 1973. In 1975, RCA launched Satcom I; in 1976, Satcom II. The availability of transponder capacity and the reliability and capability of that capacity, opened new potentials for service, particularly in those areas of the country where terrain and climatic extremes made ordinary wire and microwave systems economically impracticable -- in other words, in areas such as bush Alaska. The original ACS purchase contemplated feasibility studies for satellite service to less than 50 sites in the State. Increasingly, satellite service to virtually all points in the State became a feasible concept.

It would be pleasant to record that these disparate forces, far exceeding in scope and degree any extrapolation from the prior decade, and embodying disparate telecommunications requirements and goals, conjoined in a naturally harmonious whole. They did not. Alascom's initial proposals for service to the bush areas met resistance from the State of Alaska. Reflecting,

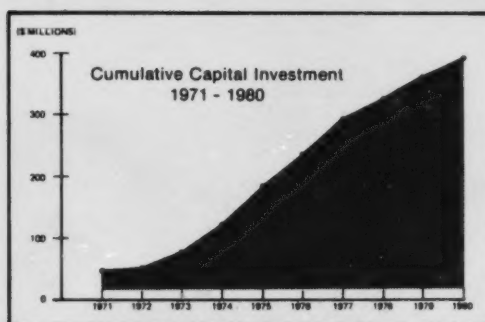
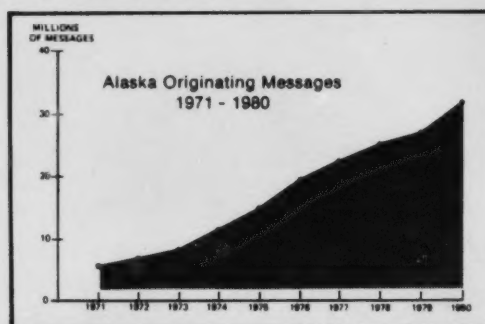
perhaps, the effects of the growing political force of those regions, and perceiving the first flow of tax and royalty revenues from the oil wealth that was, in 1981, to bring approximately \$4 billion into its coffers, the State sought more extended use and extensive reliance upon satellite facilities, in configurations different from those proposed by Alascom. The State went so far as to procure pieces of some earth station facilities, and to seek FCC authorizations to operate the network itself. A compromise was reached in 1975 which permitted Alascom to build and operate 100 small earth stations throughout Alaska in trust, pending FCC license approval. Subsequently, the State withdrew its applications from before the FCC. The compromise, however, compelled the field installation of prototype SCPC equipment, often in villages with no regular source of electrical power. Initial development, maintenance and operational costs were thus increased, even over the increased amounts occasioned by the expanded use of satellite facilities themselves. Other policies set the Company and the State on different tracks. The State argued to the FCC, for example, that Alascom should never own, but should only lease transponder capacity on a short-term cancellation basis. Alascom sought, and obtained, approval for more secure arrangements. To anyone familiar with the recent and extensive litigation surrounding the Satcom III transponder shortage in 1980, the wisdom of the latter course is apparent; but the circumstances of 1980, in such a rapidly changing field as telecommunications, were as difficult to foresee in 1975, as those of 1975 had been in 1970.

Other challenges to the provision of telecommunications abounded. A new microwave system linking major communities in Southeastern Alaska was constructed and placed into service in 1975, finally retiring tropospheric scatter facilities incapable of meeting the service demands presented. Major earth stations were constructed throughout Alaska to replace other antiquated tropospheric scatter facilities of the WACS. Gateway earth stations were constructed in Juneau and Anchorage, Alaska, to attend to increased traffic demands and to secure the protective alternate route and redundancy needs of a system increasingly dependent upon satellite communications for the majority of its traffic. In conjunction with the State of Alaska, a statewide television network began, with real-time and tape-delayed broadcasts being beamed to villages throughout the State.

The technical demands upon Alascom in creating the major portions of Alaska's telecommunications network entailed concomitant economic requirements, as well. The original commitment of \$28 million in capital expenditures, substantial by 1970 standards, was, by 1976, understated by an order of 10 magnitude. By the end of its first decade of operations, Alascom had invested over \$400 million capital dollars in meeting the telecommunications needs of the State. The recovery

of operating revenues from rates and inter-carrier revenue pools -- a prosaic matter for Lower 48 telephone companies in the 1970's -- was a novel issue in Alaska. The Ozark Separations Manual, for example, was not adopted in Alaska by the Alaska Public Utilities Commission until 1976. It was not applied by the FCC to Alascom's interstate operations until 1981. In the interval, extensive negotiations, regulatory proceedings, and judicial activity were required by Alascom to establish the basic framework for rate and revenue development and to secure its present economic stability.

A statistical stillframe of Alascom today suggests the substantial degree to which the telecommunications challenges of the past decade in Alaska have been met.



Alaska telecommunications have progressed from obsolescence to the forefront of applied state-of-the-art technology and for the moment, it might appear that Alaska has overcome its past and overtaken the future in telecommunications. The end, however, is not yet in sight.

IV. ALASKAN TELECOMMUNICATIONS IN THE 80'S: CHANGE AS A CONSTANT.

As they have in the past, changes in the nature and the direction of Alaskan telecommunications are likely, and are likely to proceed from two principal sources.

The first will be those factors indigenous to the telecommunications industry itself. As the 1980's open, our industry faces significant change as a result of regulatory and Congressional

activity, designed to apply to the telecommunications marketplace the precepts of competition. The manner of that application, as the multiplicity of FCC decisions, Congressional bills and amendments, and individual party position papers suggest, is not self-evident. Many questions remain to be answered, particularly those affecting the provision of basic telecommunications services to those in this country on the economic byways, rather than the economic highways, of telecommunication. Universal service, a goal elsewhere long since realized, is only now becoming in reality in Alaska. Alascom was originally authorized by the FCC and the APUC to operate initially as the sole long-lines carrier for Alaska precisely because of the economic imperatives flowing from unified service provisioning to a small, widely scattered population by means of a cost-effective, but not cost-free, modern technology. Questions concerning deaveraged rates, competitive pricing, and geographic market entry and withdrawal, therefore, are vital, not theoretical, matters to Alascom's customers in the bush, whose "product elasticity" choice is between a continuously available telephone and a once-a-week bush aircraft.

Percentage Of Main Stations Per Household	
Continental U.S.	97%
Alaska	92%
Rural Alaska	13%

The second, and equally important source, will be changes in the State of Alaska itself. The effects of the oil development of the mid-1970's portend to remain with the State for the remainder of this decade, as oil related revenues continue to stimulate, directly and indirectly, the State's economy. The proposed natural gas pipeline through Alaska would enhance that circumstance. Alaska, moreover, may prove a significant future source of natural resources for the nation in many other materials. A 1980 report compiled by the Alaska Division of Geological and Geographic Surveys outlined the potential for developing more than 20 minerals in Alaska. These include four primary "strategic" minerals required by the United States and for which it is presently dependent upon foreign sources: cobalt, manganese, chromium, and platinum. Trial usage by foreign firms of Alaska's coal reserves, among the largest in the United States, has been planned. Alaska's timber and fisheries resources may also prove of increasing importance to the nation.

All these considerations suggest that as the 1980's proceed, the relative importance of and the activity relating to Alaska will increase. Change in the nature and intensity of this

activity will bring concordant changes in the demands for telecommunications services. Underlying these changes will be structural modifications to the industry itself, brought about by the political, economic, and regulatory forces attending "competition" in telecommunications.

The prospects for Alaska telecommunications, thus, unlike Mr. McGinniss' novel, have no end, merely a constantly renewed beginning. Alascom, in a sense, has never enjoyed the relative luxury of any stasis since its beginnings a decade ago, and is thus uniquely positioned and adapted to face change, whether structural within the industry or arising from the character of the State of its incorporation. We look forward to that challenge.



TELECOMMUNICATION SERVICES IN THE PHILIPPINES

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ABSTRACT

The Philippine telecommunication sectoral organization is patterned after the American model. As characterising situation in a number of developing countries, service provision is generally inadequate and has tend to concentrate in the urban core. Increasing realization of the critical role telecommunications plays in national economic development has paved the way for accelerated sectoral expansion in the immediate years ahead.

I. SOCIO-ECONOMIC PROFILE

1. Geographical Setting

The Philippines is an archipelago of 7,100 islands surrounded by South China Sea to the west, the Pacific Ocean to the east and Celebes Sea to the south. North of the Philippines are Korea and Japan, to the west are China, Vietnam and Thailand, to the south are Indonesia, Papua New Guinea, Australia, Singapore, Malaysia and to the east is Guam.

Total land area of the country is 300,000 square kilometers which is divided into three major island groups: Luzon, with an area of 141,400 sq. km., Mindanao, with an area of 102,000 sq. km., and Visayas with an area of 56,600 sq. km. These groups are further divided into thirteen regions including Metro Manila, into 75 provinces, and into 1,599 cities and municipalities.

The geographical terrain is characterized by intensive valleys, mountains, marshlands and coastal plains with elevation ranging from sea level to mountainous peaks reaching almost 10,000 ft. It is flourished with 61 natural harbors, 20 landlocked straits and hundreds of bays, rivers and lakes. Manila has one of the finest harbors in the world.

The natural resources of the country include arable land, a large variety of hardwood timber and extensive ground and quantities of minerals. Mineral wealth includes an abundant deposits of both metallic and non-metallic minerals. The Philippines has numerous fishing grounds which are widely dispersed. Its offshore and deep sea areas, fresh water areas and swamplands are well stocked with an assorted variety of edible fish.

The country's climate is tropical as a whole. Since temperature differences in the archipelago are very slight and since rainfall differences are definitely varied due to the combined influence of topography and air stream direction, the classification of Philippine climate has been based on the types of rainfall.

2. Cultural Characteristics

The official language are the native Pilipino, English, and Spanish. The people however are bilingual in the sense that they speak both English as well as their distinctive dialects which are mostly of Malays-Polynesian and Sanskrit origin. There are 86 indigeneous dialects aside from the national language-Pilipino, but only three are of regional importance: Cebuano, spoken in some parts of the Visayas and Mindanao area, Tagalog in the Metro Manila area and most of Central and Southern Tagalog and Ilocano, in the northern Luzon and portions of Southern Mindanao.

Reflecting on the influence of spanish rule, 85% of the country's population are Catholics.

3. Economic Condition

By general standard, the Philippines is a developing country. By World Bank's classification in particular, it falls in the category of middle income developing countries. Some macro-economic indicators on the state of Philippine development are as follows:

- Overall economic growth has been respectable at 6.4% yearly from 1970-1980.
- Total population is 47.9M with 2.6% average annual growth rate from 1975 to 1980.
- GNP per capital of \$708 as of 1980. In real terms, per capita GNP has been increasing at an average 3.6% annually from 1970-1980.
- Inflation rate during the last decade has been exacting at 15% annually.
- Urbanization rate stands at 36%.

- Crude birthrate is 34 per thousand compared to a crude death rate of 8 per thousand as of 1979.
- Proportion of population of working age (defined as 15 to 64 years) is 53% in 1979.
- Adult literacy rate is rather high for a developing country at 88% in 1976. Average for developing countries is less than 70%.

II. SECTORAL ORGANIZATION

As one of the vestiges of its colonial past, the telecommunications sectoral organization in the Philippines is patterned to a large extent after the structure in the United States. Service is extended primarily by private entities and the government exercises regulatory power over the sector. There is one dominant voice carrier and a host of independent telephone operators. Likewise, record service is provided by several international and domestic carriers. There is also a carrier's carrier which provides international satellite circuits and another one handling domestic satellite circuits. A deviation from the American model is the presence of the government as voice and record services operator in some areas.

The Philippine Long Distance Telephone Co. (PLDT) is the biggest voice carrier accounting for 93% of telephone in service and with the most extensive toll facilities and international and domestic toll message services. Some 61 independents and the government-owned Bureau of Telecommunications (BUTEL) serve the remaining 7% of telephone stations. Late 1980 and early 1981, PLDT acquired the assets and operations of 2 of the largest independent companies which together account for 9 of the 93 percentage points representing PLDT's share.

International record service is extended by four (4) carriers namely: Eastern Telecommunications Phils. Inc. (ETPI); Philippine Global Communications Inc. (Philcom); Globe McKay Cable and Radio Corp. (GMCR) and, Capitol Wireless Inc. (CAPWIRE). The last one is also extending domestic record service along with 10 private entities and BUTEL. Of the domestic operators, 1 provide telex service only, 6 private entities provide telegram service only, and 4 private entities and BUTEL are involved in both telex and telegrams service.

Phil. Communication Satellite Corp. (PHILCOMSAT) and Domestic Satellite Phil. Inc. (DOMSATPHIL) act as carriers' carriers, for international and domestic satellite circuits, respectively. Ownership on international submarine cables and domestic toll facilities

other than satellite, however, rest in the different carriers.

Regulation over this sectoral set-up is vested in the National Telecommunication Commission, a quasi-judicial body under the Ministry of Transportation and Communication'

III. TELECOMMUNICATIONS SERVICES AND FACILITIES

As a common feature of a developing country, telecommunications services and facilities in the Philippines are inadequate. This is traced to a multitude of problems characterizing a developing country the most prominent of which are scarcity of capital resources, existence of other sectors competing for limited investment funds lack of skilled workers, and absence of complementing structure in some areas of the country.

1. Local Service

As of June 30, 1981, there are 707,000 telephone stations in service of which 537,000 or 76% are located in Metro Manila. The remaining 24% are spread over the major cities and municipalities. Service is extended by 61 private entities and the government's BUTEL which collectively operate 216 telephone exchanges'

- As a whole, there are 1.36 telephones per 100 inhabitants. But on a more specific level, Metro Manila has a telephone density of 8.02 while the rest of the country has only 0.38 telephone per 100 inhabitants.
- Out of 1,599 cities/municipalities, only 237 have local telephone service.
- Somewhat reflecting on the investment capability between large and small operators, PLDT is currently implementing an expansion program which sees the introduction of SPC lines in Metro Manila and the provinces. At the other side of the spectrum, the small operators have neither undergone significant expansion nor modernization. To date, of the total number of exchanges, 16% are manual exchanges, 81% are strowger and various types of crossbar exchanges, and 3% are electronic exchanges.
- Telephone traffic especially in Metro Manila is extremely high and exchanges are configured for around 0.20 erlang per line. Such high traffic is traced to a variety of problems which include inadequacy of telephone lines, large family size, extended family system, and the flat rate system of pricing existing in the country with the exception of a small portion of Metro Manila.

- Rates and tariffs for telephone service are relatively low. In Metro Manila which generally has the highest charges, a residential single line subscriber pays approximately \$8 monthly, an individual business line is charge \$17 monthly.

2. Domestic Toll Services

Domestic toll facilities in the Philippines is generally composed of microwave backbone routes and UHF/VHF spur links. Domestic satellite circuits are also available.

- PLDT has the most extensive toll backbone network in the country starting from Mt. Sto. Tomas up north reaching Davao del Sur down south. From Manila northward, the network has a capacity of 960 channels up to Central Luzon and 300 channels thereafter. Southward from Manila, capacity is 600 channels up to Cebu and 300 channels thereafter.
- Other carriers with microwave facilities are BUTEL (Attachment II) and Phil. Telephone & Telegraph Co. The latter has a backbone capacity of 120 channels.
- Toll facilities are also extended by DOMSATPHIL via one and one-half (1-1/2) transponders from the Indonesian PALAPA satellite. One transponder is allocated for TV program transmission while the other half transponder with an equivalent of 150 two way voice-grade circuits is used for message services. Ground segment is composed of 11 fixed-type earth stations with 11 meter diameter antenna and 1 transportable type earth station with 4.5 meter antenna. Terrestrial links are provided by PLDT.

Toll services offered in the Philippines and extent of service provision are as follows:

a. Domestic Message Toll Service

- Service is provided to 251 of the 1,559 cities/municipalities by both PLDT and BUTEL as of mid-year 1981 primarily through microwave backbone facilities and UHF spur links.

- A total of 10.2 million messages were generated in PLDT system for the 12-month period ended December 30, 1980. This is equivalent to a very low 28 domestic toll messages per PLDT main stations annually. Growth is, however respectable at 17% annually for the past 10 years.

- Somewhat reflecting on the telephone distribution in the country, 73% of the messages originate or terminate in Manila.

- A total of 2,696 toll trunks are in service passing through a series of 24 relay stations.

- Direct distance dialling is being introduced to limited number of PLDT subscribers who are connected to SPC exchanges in Metro Manila.

b. Domestic Record Service

- For 1980, a total of 31,600,000 domestic telegrams were sent by the public representing an annual increase of 6% over 1971 level. In comparison, domestic telex traffic registered 2,900,000 minutes for the year.
- Telegram service is available in 1,314 of the cities and municipalities in the country. However, in 23% of the area with available service, two or more service providers exist.
- Of the various operators, BUTEL has the widest area coverage with its service reaching 1,291 cities and municipalities. The 10 private operators account for the other 23 municipalities.
- Only 62 cities/municipalities have telex service and in 61% of these areas, service is extended by two or more operators.

c. Radio Broadcasting

- There are 322 radio stations serving the country, 76% of which are AM stations and the remaining 24% are FM stations. A total of 44 stations are located in Metro Manila.
- Of the total radio stations, 9% are government stations, 4% are religious stations, 1% are Philippine and U.S. military stations, and the rest are commercial stations.

d. Television Broadcasting

- There are 38 TV stations all over the country, 5 of which are situated in Metro Manila.
- A simultaneous TV broadcast is made possible by means of existing microwave carriers domestic satellite, and/or through TV translators. There are 55 TV translators serving the country.

d. Others

Other services include ship to shore communication, paging system and manual land mobile communications.

3. Overseas Services

Facilities include both satellite and submarine cables.

- International satellite communications are available through PHILCOMSAT which operates two standard A earth stations - one facing the Pacific Ocean and the other directed at the Indian Ocean. Both earth stations are located in Pinugay which is 40 miles from Manila. A third earth station, (standard B) is used for restoration facilities services in Pacific Ocean Region. This is also located in Pinugay.
- Submarine cable links connect the Philippines with some neighboring countries. These cables, their corresponding capacity and in-service dates are as follows:

CABLE LINK	(CKTS)	IN SERVICE DATES
<u>Curimaos, Ilocos Norte</u>		
<u>Cable Head</u>		
Phil.-Singapore (PhilSin)	1,380	1978
Phil.-Hongkong (LUHO)	1,380	1977
Phil.-Okinawa, Japan (OLU)	1,200	1977
Phil.-Taiwan (TAILU)	480	1980
<u>Baler, Aurora Cable Head</u>		
Phil.-Guam (TPCI)	144	1964

International services available are the following:

a. International Telephone Service

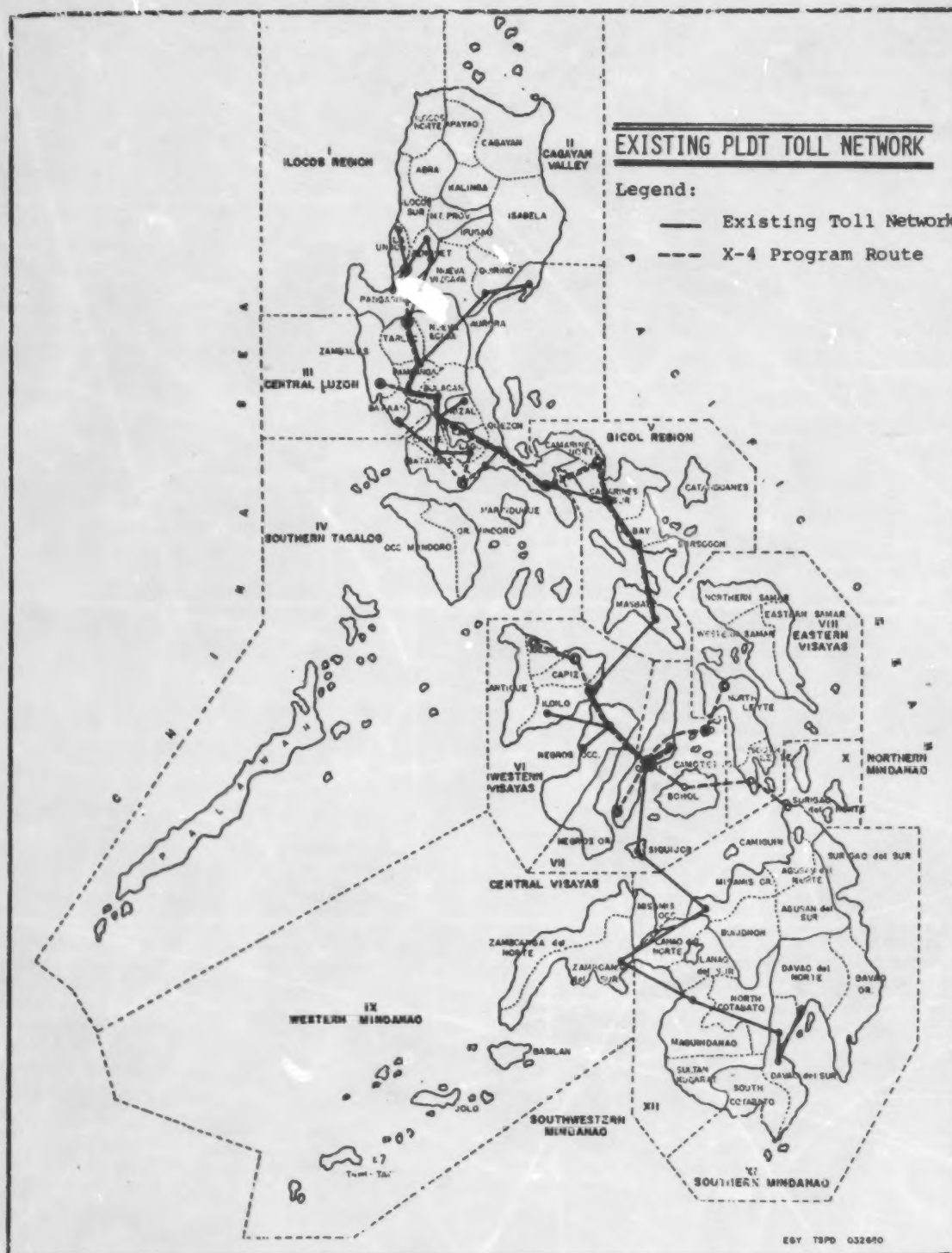
- Number of international tel. messages reached 2,054,000 on 1980 representing annual rate of increase of 23% over the past 10 years. PLDT operates the international gateway for voice in the Philippines.

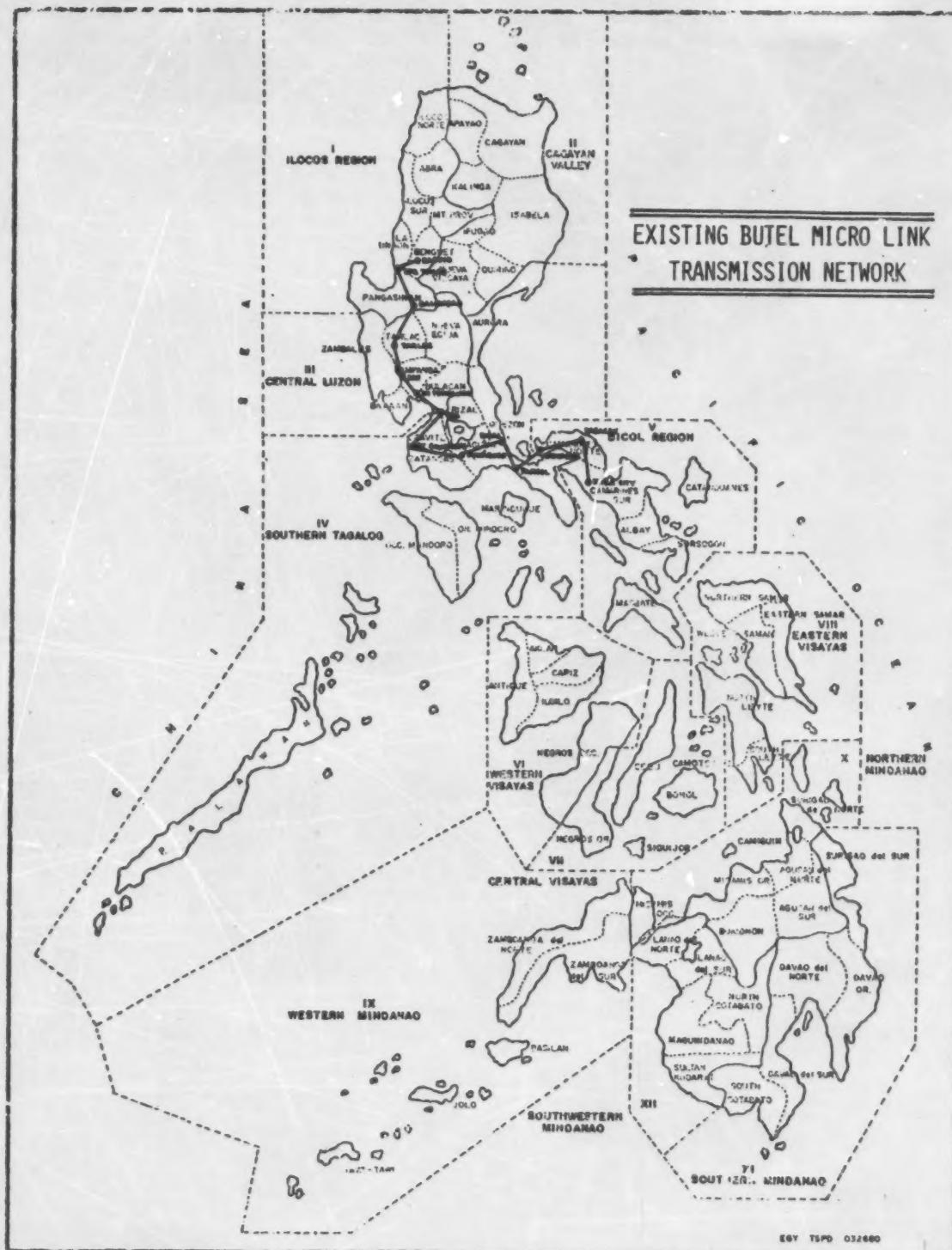
- Service covers calls to 190 countries of which 24 are reached via direct routes. A total of 467 circuits are in service of which 190 connects the country with the United States. Asia and Pacific streams account for 205 circuits while Europe, India and the Middle East account for another 72. Manila serves as the international gateway.

- International subscriber dialling is available to a limited number of Metro Manila subscribers to 16 countries/territories as follows: USA, Hawaii, Canada, U.K., Singapore, Germany, Hongkong, Spain, Japan, Australia, Taiwan, Indonesia, Switzerland, Malaysia, France, Italy.

b. International Record Service

- As of 1980, there are 5,341 international telex subscribers making a total of 7,287,000 of outgoing calls. Between 1971 and 1980, telex traffic registered a compounded annual growth rate of 20%.
- International telegram messages, however, have registered continuous decline from 1,513,000 in 1977 to only 596,000 in 1980 or an annual reduction of 36%.
- Other record services offered by the record carriers include Bureau fax and marine telegram. Access to international data services such as Telenet and Tymnet are also provided.
- A total of 43 voice-grade circuits connecting the Philippines to 18 major cities in the world are used in providing international record service as of September 1981. Connections with other international locations are established by transitting via these points.





- Due to the existence of four entities in service provision, competition characterized the market for record service.

c. Others

Some other services extended by international carriers include occasional TV transmission and full period lease circuits. In September, 1981, there are 78 full period leased circuits to various international cities.

IV. SECTORAL RATIONALIZATION

At its present state, a number of problems beset the sector:

- Limited geographical coverage due, in most part, to capital resource deficiency.
- Service duplication in some areas manifesting a tendency of operators to stay in more profitable areas.
- Service is still inadequate in relation to requirements in most part of the countries. While service has been concentrated largely in Metro Manila, service capability in this urban hub has still to meet requirements.

Sectoral rationalization is also being implemented and specifically, the last three years saw some definite steps taken towards such direction. These are as follows:

- Creation of a separate ministerial portfolio for Transportation and Communication.
- Integration of operations. BUTEL is gradually withdrawing from areas where it duplicates a private telephone system. It phased out its Metro Manila operations in 1976. Likewise, PLDT has been absorbing the facilities and operations of some of the independent companies.
- Development of a Master Plan for Telecommunications for the country through a joint effort between the private and public sectors.
- Through government-to-government arrangement, the ministry is securing soft loans to finance telecommunications facilities in areas where there is an almost total absence of service.

V. EXPANSION PROGRAMS

Due to the increasing awareness of the sector as an important element in economic development, investment in telecommunications is occurring at an accelerated pace with the active participation of both private and government sectors.

The MOTC, in coordination with the National Economic Development Authority (NEDA) has developed a plan calling for the following:

1. Meet total demand for telephone, telegraph and telex services by the year 2000. This will result in 5.6 million main stations nationwide and establishment of telegraph service in the remaining unserved municipalities.
2. Introduction of new technology for telephony.
3. Expansion and upgrading of training facilities.
4. Establishment of in-country manufacturing capability.

The plan divides development into different timeframes. For the period 1983-1987, in particular, a total investment requirement of ₱10.7 billion (\$1.34 billion) has been estimated. Included in the period's program is the installation of some 535,000 lines of which 325,000 are for the provinces.

Some of the significant expansion programs being undertaken or near implementation are the PLDT X-4 Program and the government's Northern Luzon, Visayas and Mindanao projects. The PLDT program was considered in the preparation of the overall telecommunication by MOTC and NEDA. The government projects are in line with the Plan.

1. PLDT

PLDT is in the midst of implementing its X-4 Expansion Program which covers the period 1978-1984. Compared to its existing plant in service, the program is significant in both monetary value and physical quantities. It shall amount to approximately ₱6 Billion, and within the seven-year time frame, it shall increase PLDT's plant in service to more than three times level prior to the start of the program.

In particular, the program calls for the following:

a. Service Improvement/Upgrading

- introduction of DDD and ISD
- use of SPC switch in local service provision
- introduction of metered service
- reduction in partyline service
- provision of new subscriber services and features including pushbutton dialling, abbreviated dialling and do-not-disturb service among others
- provision of automatic mobile telephone service

- upgrading of microwave backbone facilities and relocation of relay stations
- replacement and retirement of obsolete equipment including facilities of existing interconnecting companies and toll stations.

b. System Expansion

- Expansion of basic telephone service from 250,000 to 430,000 main stations in Metro Manila or an increase of 75%. This involves additional 200,000 SPC lines and retirement of some Strowger switches.
- expansion of telephone service in provincial exchanges from 55,000 to 75,000 main stations, representing an increase of 35% of the additional 16,000 are SPC lines.
- addition of 2,958 circuits and 344 switchboard positions for domestic toll operations. Number of circuits and switchband existing prior to program start were 1,214 and 106, respectively. The additional circuits will come from the establishment of a 1,800 channel backbone network which will run almost parallel to the existing 960 channel network.
- addition of 503 circuits and 134 switchboard positions for overseas toll operations to the 1977 level of 244 and 30 respectively.
- establishment of 2 service centers, 7 service yards and 64 central office buildings.

c. System Extension

- establishment of basic telephone service to 60 municipalities.
- provision of toll telephone service to 67 municipalities and toll station service to 66 municipalities.
- setting up of 3 toll centers and 11 relay stations.
- provision of 96 toll data channels.

As a percent of GNP, PLDT's investment alone would average 0.3 over the seven-year period.

Before the X-4 program ends, the X-5 program shall be implemented to commence on 1983. Although this is still in the planning stage, it is envisioned to be bigger in size than its immediate predecessor and shall also place greater emphasis on regional telecommunications and introduction of new technology and services. When that portion of X-5 investment that is to occur in 1983 and 1984 is added to X-4 investment budget, the average PLDT investment to GNP ratio for 1978 to 1984 shall even be higher.

Figure above exclude that portion of facilities which were absorbed from two of the largest independents late 1980 and early 1981 in line with a move towards service integration.

2. Government Projects

The government is also initiating a project to provide telecommunications facilities to the Northern Luzon regions. Foreign-sourced components of the project is to be funded by soft-loans from Japan.

Broadly, the project calls for the following:

- establishment of local telephone exchanges in 47 municipalities, a few of which are expected to replace obsolete equipment in existence.
- the exchanges shall be interconnected into a contiguous network with 12 to 120 channels UHF radios but initially equipped for 6 to 78 channels.

Interconnection with the PLDT national network is also to be effected. To this end, coordination meetings are being held to ensure proper interfacing and timing.

A second and third projects, covering the Visayas and Mindanao regions are being contemplated by the government. These are to be similar in purpose and scale to the Northern Luzon project.

Basic
Telecommunications
Services:
Policy Considerations

Telecommunication Issues in a
New World Information and Communication Order

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1. Abstract

New technologies provide the opportunity to serve all communities with telecommunications to support economic, social and cultural progress. The policy considerations give high priorities to the importance of information transfer and two-way communication flows for which there is now an increasing reliance on telecommunications.

2. PROGRESSIVE EVOLUTION OF
TELECOMMUNICATIONS

There has always been some recognition in telecommunications of the inter-active relationship between the interests of users and the services put at their disposal.

The research and development sectors of telecommunications have always been classified as innovators. They made steady progress from the turn of the century with the development of the monumental marvels : the automatic telephone and telegraph type networks. In parallel with this progress we have had the very significant developments in radiocommunications, such as for mobile services to meet the needs of aircraft and ships, various terrestrial systems, sound broadcasting and later, television.

However, during the last 15 years we have witnessed continuing spectacular development in the means of telecommunication due to : not only the progress in the sector itself, but also the application of the dramatic break-throughs in other sectors to telecommunications systems :

- space research (highly dependent upon telecommunications for its functional objectives),
- application of computer technology to telecommunications, and
- practical realization of many changes in the broader electronic sector, specially transistor and solid state technological development, solar power energy, etc.

The application of these results has brought the possibility of instantaneous telecommunications to, or between, any points on our globe at a relatively cheap operational cost. Indeed, the progress offers the opportunity of dramatic unit cost reductions unsurpassed in any other major service sector.

We have the capacities now for both two-way communication and rapid transfer of information in the form of voice, recorded message or video presentation, including (without any undue technical difficulty) direct television to the home from

switching points (satellites) in the geostationary orbit of outer space.

It was inevitable that with the progressive merging of some of these technologies wider issues of national and international policy considerations would arise.

New communication transmission possibilities, or functional objectives such as remote sensing of the earth and direct television broadcasting space applications, which are highly dependent on telecommunications systems - indeed broadcasting is a means of telecommunications - have both positive and negative elements.

3. CONSEQUENCES OF NEW TECHNOLOGY
APPLICATIONS

Whilst there is a tremendous potential for the adaptation of these scientific realities, it has been recognized that some of these new communication functions can have a consequence on traditional values. Societies have regularly undergone changes throughout the decades, but never before has there been so many facilities and consequences to bring into use at such short notice.

Thus, it is no surprise that the possible consequences of new telecommunication developments on culture would also be raised.

Reflect for little on the future of telecommunications in the words of the British Science Journalist, Calder :

"Think of a system incorporating computing, publishing, newspaper, broadcasting and library, telephone and postal services of a country, together with slices of teaching, of operations and of many professional activities."

We see, of course, the consequences of other developments in our communities, such as the extended use of electronic tools, the pocket calculator and related coding and decoding devices which have become an every day reality.

An important issue is for each country to be able to judge the appropriateness of such applications, consistent with their own national aspirations and development needs.

4. OTHER RELATED POLICY CONSIDERATIONS

Let us reflect for a moment also on other pressing priority areas of policy taken up in other governmental fora, and especially the unique political forum of the United Nations General Assembly and its bodies. There are the questions of the higher priorities given to such important resolutions regarding elements in International Development Strategies, including the New World Economic Order:

- (a) transfer and application of technology, and its sharing with and throughout all countries, including for social and economic development in the rural areas,
- (b) importance of information transfer for development,
- (c) concern and implications of communication technology on social, economic and cultural development.

Then, there is the growing recognition that with a combination of telecommunications and appropriate information treatment capacities one has an essential ingredient to serve more effectively many key sectors: agriculture, education, health, industry, transport, social welfare, government administration, to quote a few examples.

In effect, provision of such basic infrastructures are essential adjuncts to economic and social health.

A vital question at issue now is the extent to which in the interdependent world in which we all exist, there will be an effective sharing of the telecommunications' capacities for development, and the appropriate re-shaping of priorities.

Here we have some basis for changes in developed and developing countries. The approach and results of both have, however, been different.

Developed countries with their industrial bases have adjusted somewhat easily to the new means - perhaps one area of major concern being privacy issues in computer processing and to some degree transborder data flows. In effect, the existing bases have enabled the integration of the new technologies to service needs without great difficulty.

Developing countries have realized the potential of the new tools. On the other hand, they have seen, in general, the widening of gaps in development. As well they have expressed their concern on the national economic and cultural implications inherent in one-way "free flow", because of the absence of their infrastructures and their inability to engage in two-way flows of communication. Hence the notion of "balanced and equitable" flow, leading to a concept of a New World Information and Communication Order, as yet undefined. Of special relevance is the United Nations' Resolution No. 35/201 (December, 1980): Questions Relating

to Information (Extract - Annex 1), inter alia:

- . collaboration for the establishment of a New Order,
- . endorsement of a New International Programme for the Development of Communication (IPDC).

Even if some uncertainties in relation to the New Order provide for some controversy, all will agree on the importance of the telecommunications infrastructure if there is to be adequate provisions made for rapid information transfer and a "balanced and equitable" flow capacities.

Recently, at the 28th Plenary Assembly (1) of the World Federation of United Nations Associations, there was a special Seminar on the question of the New World Information and Communication Order with the participation of a number of the Members of the International Commission for the Study of Communication Problems (2), which led to some interesting exchanges of which three of the principal conclusions were:

- (a) balanced and equitable flows of information can only be achieved, in reality, through an adequate telecommunications infrastructure (for both international and internal communications needs),
- (b) the importance of providing adequate advice and information to enable countries to be aware of the importance of communication for development and thus to be able to take decisions on the proper priority for communications within the national development programmes,
- (c) a major obstacle to greater international exchange of information lay with some of the existing charging (tariff policy) followed by countries.

5. FUTURE TELECOMMUNICATION CONSIDERATIONS

Here is a background to some of the issues which will affect telecommunication development in the next decade or more. From the viewpoint of telecommunications they will inevitably be reflected in the considerations of national policies when Member Governments reach towards international discussions and negotiations inside and outside the ITU:

- for the basic cooperation in working out the practical regulatory needs to permit each country be it a large or small user, to plan and operate its services in accordance with its own practical national aspirations consistent with the International Telecommunication Convention and associated international regulations. They are supplemented by national legislative arrangements, practices and procedures, as well as bilateral and multilateral operational arrangements,

- for the acceleration of the development process, heavily dependent on structures for information transfer and access, and especially for national economic planning development.

Decisions of Governments in the ITU (as an institution of 157 Member Countries) will have a significant impact for :

- the introduction and integration of new technologies into the world of telecommunications, as well as the planning and use of the radio frequency spectrum and the geostationary satellite orbit, and
- the promotion of the realization of telecommunication development.

6. TELECOMMUNICATION REGULATION, COORDINATION AND STANDARDS

Already the ITU Administrative Council has endorsed a programme of administrative conferences for the rest of the decade (Annex 2). The programme was established initially at the World Administrative Radio Conference, 1979.

We should note the importance of such regulatory conferences which will produce new treaty provisions, negotiated and agreed between Member States for the planning, coordination and establishment of radiocommunication services including for the use of the radio frequency spectrum and the geostationary satellite orbit.

We should note, too, that the results in the case of world conferences will entail the revision of the Radio Regulations and, in the case of regional conferences, the elaboration of mutually accepted detailed Plans for the bringing in operation of services. The importance attached to broadcasting and television, i.e. mass communications, is emphasized by the Programme.

The important issue will be to work out acceptable procedures that will enable the planning of services to provide two-way flow infrastructures, without any economic penalties for latecomers, including the appropriate sharing of the national resources (the radio frequency spectrum and the geostationary satellite orbit).

The conference considerations permit in reality a regulatory overview of technology for its effective application. They represent a form of prerequisite (indeed a preinvestment requirement) in order that the telecommunication systems of countries can be planned either to coexist where the radio frequency spectrum is involved, or to provide the necessary provisions to permit communications between systems.

Equally so, we should not underestimate the work carried out in the Consultative Committees : the CCIR (International Radio Consultative Committee) and the CCITT (International Telegraph and

Telephone Consultative Committee). They will provide many new recommendations on the means to adapt technologies and to interconnect national telecommunication systems.

7. TELECOMMUNICATION DEVELOPMENT

Factors in Development are matters of national programming and priorities.

The United Nations System has a practical executing role through the provision of advisory assistance on :

- the realization of development, and
- the promotion of development,

with well defined field project activities for the planning and establishment of improved infrastructures.

By far the most significant contributions will be through arrangements between countries.

However, in addition to normal project activity under the United Nations Development Programme, and as a consequence of the research by the ITU, field studies on modern technology options for the rural areas are being prepared.

In effect, we see various examples of the significant sharing of technology which is already well established but which has not yet really served the rural areas.

Hence the importance of rural telecommunications in the next decade taking account of the need to rethink the traditional approach to investment in rural services and the sources of funding and the new technical possibilities which have been outlined. The ITU Secretariat, itself, has various studies proceeding which would help to identify better the importance of the sector as a contributing support to development.

8. TELECOMMUNICATION TARIFFS

It is natural that users of telecommunications would wish to see the lowest practicable charges (tariffs) for services. Various resolutions in international fora have been passed with a view to achieving lower charges. In particular, attention is invited to the Resolution No. 4/22 (Annex 3) of the Unesco General Conference which, in seeking a review of what the representatives at that Conference acknowledged as obstacles to development.

It will be noted that special emphasis has been given to the consideration of the matter at the highest national policy levels. The competing demands on the governmental authorities necessitate that this matter be treated by governments on the basis of their individual national priorities, including budgetary and financial concerns.

Each is different. Many, especially developing countries are faced with the problem of financing a significant proportion of their telecommunication development from their existing users, taking account of the policies which have customarily been followed, and which necessitate review.

New and appropriate technology and greater productivity naturally provide scope for lower costs for telecommunications especially as the size of individual systems and networks increase.

There is a need for a determination at the national policy level between the competing interests that may be involved.

Thus, the ITU Secretariat has joined with the Unesco Secretariat in collective studies of this matter which is recognized as a critical issue in assisting the development of local news agencies and the improved flow of news and information associated with the service priorities referred to in the Unesco Resolution.

We emphasize again the importance of this matter being sited in the individual national environment against the background of national objectives, a position which has been supported by the Members of the ITU in the VIIth Plenary Assembly of the CCITT and the Administrative Council of the Union.

9. CONCLUDING COMMENTS

In today's outline I have endeavoured to bring before you various issues which will affect international cooperation and collaborative efforts inside and outside the Union, in the course of the next decade of telecommunication development.

- (1) Geneva, 12-16 October, 1981
- (2) "Many Voices, One World" (MacBride Commission Report)

ANNEX 1

Resolution No. 35/201 : Questions relating to Information

The General Assembly,

Recalling its resolutions 3535 (XXX) of 17 December 1975, 31/139 of 16 December 1976, 33/115 A to C of 18 December 1978 and other relevant resolutions of the General Assembly on the question of information, in particular, resolutions 34/181 and 34/182 of 18 December 1979,

Recalling article 19 of the Universal Declaration of Human Rights, which provides that everyone has the right to freedom of opinion and expression and that this right includes freedom to hold opinions without interference and to seek, receive and impart information and ideas through any media and regardless of frontiers, and article 29, which stipulates that these rights and freedom may in no case be exercised contrary to the purposes and principles of the United Nations,

.....

Considering that the publication of the report of the International Commission for the Study of Communication Problems is a valuable contribution to the study of information and communication problems and that the debate on the report could also help to stimulate the participation of Governments, professional circles and the public in the process of the establishment of a new world information and communication order,

Conscious of the complementarity of the activities in the field of information and communication and the need to strengthen cooperation and coordination between the organs, organizations and bodies of the United Nations system that deal with different aspects of information and communication,

Recalling the need to strengthen the coordination of the activities of the United Nations Educational, Scientific and Cultural Organization with the other specialized agencies concerned, particularly with the International Telecommunication Union, in the field of information and communication,

Mindful of the need for all to collaborate in the establishment of a new world information and communication order based, *inter alia*, on the free circulation and wider and better balanced dissemination of information, guaranteeing the diversity of the sources of information and free access to information, and, in particular, the urgent need to change the dependent status of the developing countries in the field of information and communication, and intended also to strengthen peace and international understanding,

Affirming that the establishment of a new world information and communication order is linked to the new international economic order and is an integral part of the international development process,

.....

1. Expresses its satisfaction with the relevant resolutions as adopted by the General Conference of Unesco at its 21st session, held at Belgrade from 23 September to 28 October 1980, in particular the resolution on the report of the Director-General on the findings of the International Commission for the Study of Communication;

2. Takes note of the invitation of the Director-General of Unesco to take immediate steps to initiate studies with a view to drawing up the fundamental principles underlying a new world information and communication order and exploring the possibility and desirability of such studies serving as a basis for a Declaration on the Establishment of a New World Information and Communication Order;

3. Expresses its satisfaction at the establishment within the Unesco of the International Programme for the Development of Communication, which constitutes an important step in the establishment

of a new world information and communication order and which aims at the development of infrastructures of communications of the developing countries in order to contribute to narrowing the gap in the fields of information and communication between developed and developing countries as well as among developing countries themselves;

4. Invites Governments, non-governmental organizations and other entities in Member States to extend financial as well as technical support for the development of communication structures in developing countries and in particular to the International Programme for the Development of Communication;

5. Calls upon the Secretary-General to render full cooperation and support to the International Programme for the Development of Communication and to seek and encourage interagency cooperation and the participation of the agencies in the activities of the Programme and its Intergovernmental Council;

.....

ANNEX 2

ITU ADMINISTRATIVE RADIO CONFERENCE PROGRAMME

Regional Administrative MF Broadcasting Conference (Region 2) - November/December 1981;

Regional Administrative Conference for FM Sound Broadcasting in the VHF Band (Region 1 and certain countries concerned in Region 3) - August/September 1982; October/December 1984;

World Administrative Radio Conference for Mobile Telecommunications - March 1983;

Region 2 Broadcasting Satellite Planning Conference (12 GHz Bands) - June/July 1983;

WARC for the Planning of HF Bands allocated to the Broadcasting Service - January/February 1984; January/February 1986;

WARC on the Use of the Geostationary-Satellite Orbit and the Planning of Space Services - June/August 1985; September/October 1987;

Conference to review and revise the Provisions of the Final Acts of the African VHF/UHF Broadcasting Conference, Geneva, 1963 - January/February 1986;

Planning Conference for the Broadcasting Service in the Band 1605-1705 KHz in Region 2 - September/October 1986;

Conference to establish criteria for the shared use of the VHF and UHF Bands allocated to fixed, broadcasting and mobile services in Region 3 - March/April 1988;

World Administrative Radio Conference for Mobile Telecommunications - September/October 1988;

Note

CCIR Plenary Assemblies - February 1982; March 1986;

CCITT Plenary Assemblies - September 1984; November 1988;

Preparatory Seminars WARC (HF Broadcasting), Third Quarter 1983, and WARC (Space Services) First Half 1985.

ANNEX 3

Resolution No 4/22 - Unesco General Conference, Belgrade, 1980

The General Conference,

Convinced that a new world information and communication order requires a larger and more balanced flow of news, particularly from the developing countries to other developing countries and the developed world,

Believing that a low tariff structure that the average developing country can afford is the key to the successful establishment of widespread news exchanges internationally and more particularly among countries of the developing world,

Realizing on the basis of experience that the high charges levied by the telecommunication services in various countries are the greatest obstacle to the widespread exchange of information and knowledge about each other,

Aware that the present commercial tariffs including the current Press Bulletin Service Tariffs for news, are beyond the financial capacity of the media in the average developing country, including their domestic news agencies,

Convinced that the introduction of special low tariffs for the transmission of information of all kinds is a precondition for providing most media in the developing world with the financial capacity to receive and transmit information regionally and internationally,

Recalling the proposal of the Ministers of Information of Non-Aligned Countries in New Delhi in July 1976 that non-aligned governments introduce "Suitable and concessional tariff structures for the fast flow of information among non-aligned countries", which proposal was adopted for implementation at the Summit Meeting of Heads of States/Governments of Non-Aligned Countries, meeting in Colombo in August 1976 and in Havana in September 1979 (paragraph 287 of the Declaration),

Recalling also Recommendation 15 of the Intergovernmental Conference on Communication Policies in Asia and Oceania held under the auspices of Unesco in Kuala Lumpur in February 1979, which inter alia also made the recommendation that "A tariff not exceeding US dollar 200 a month for a two-way dedicated full-time circuit be offered as a guide",

Recalling the report on telecommunication tariffs unanimously adopted at the Second Conference of the Non-Aligned News Agencies Pool held in Belgrade (22-24 November 1979), which was approved at the Fourth Session of the Intergovernmental Council for the Coordination of Information at Baghdad (June 1980) and reiterated at the Fifth Regular Meeting of the Non-Aligned Newspool in Managua (August 1980),

Drawing attention to the report of the Working Group of Unesco on International Telecommunication Tariff Structure (Paris, June 1980) and its basic recommendation that lower Development Press Bulletin Service (DPBS) tariffs be introduced, inter alia for the developing countries, at least in the following categories:

- (a) a DPBS tariff for a dedicated teleprinter circuit of duplex 50 to 75 bauds operating continuously (for news transmission);
- (b) a DPBS tariff for a telephone type circuit (for the transmission of data, pictures, voice, facsimile or a combination thereof);
- (c) a DPBS tariff for television news exchange as follows:
 - (i) occasional transmissions,
 - (ii) special events,
 - (iii) regular daily transmission and news exchanges,

1. Recommends to the Member States that, in the exercise of their sovereignty, they take the necessary policy decisions at the highest levels to afford to bona fide media, particularly from the developing countries, low tariffs as much as practicable along the lines of the tariff categories suggested in the report of the above-mentioned Working Group of Unesco;

2. Invites the Director-General to communicate this resolution to the International Telecommunication Union and to the INTELSAT and INTERSPUTNIK organizations, and to seek their collaboration.

MANY IMAGES, ONE WORLD:
Telecommunications Services and International Conflict

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Abstract

International communication has become increasingly under the impact of at least three major technological, socioeconomic and political forces: expanded channels of communication provided by technological developments, democratizing pressures that have brought new voices to be heard in international media and forums, and new but as yet weak mechanisms for the conduct of meaningful dialogue and negotiations. Power politics has been thus increasingly supplemented or supplanted by image politics, questioning traditional boundaries between domestic and international politics and creating image fixations that have proved occasionally inimical to accommodation of real interests. The symbolic uses of images, on the other hand, have served at least three kinds of cognitive interests: national solidarity, domestic instrumental and global community. The Iranian Hostage Crisis, among a number of other contemporary examples, illustrates how these interests were served in domestic as well as international politics symbolically and actually. Through a case study of the Hostage Crisis, the paper concludes with some warnings on the potentials as well as menaces of image politics.

This essay owes its origins and its title to the UNESCO debate on the role of telecommunications services in international communication and the call for a New World Information and Communication Order (MacBride, 1980). However, the paper attempts to go beyond that polemic by presenting the problem in a broader theoretical perspective and through the example of a case study in international communication, namely the Iran Hostage Crisis of 1979-81.

It will be argued here that the Hostage Crisis illustrated both the triumphs and tragedies of the "New Information Age" upon which the world seems to have embarked. It showed (1) how image politics centered on the uses of new telecommunications facilities can supersede traditional power politics in some situations of international conflict; (2) how old cultural stereotypes and new political fears blown up by the international mass media can sometimes impede progress in negotiation; and (3) how increased awareness by the public of the complexities of an international issue can also serve to limit excessive reactions to redress legitimate grievances. In other words, on balance, the ultimate outcome of the hostage crisis leaves considerable room for hope on the positive contributions of telecommunications to international relations. Neither Iran (which felt aggrieved by past U.S. interferences) nor the United States (which felt unjustly treated by terroristic tactics) used their ultimate weapons. The hostages came home safely, while no serious military actions were taken and Iranian assets were returned.

1. THE EMERGENCE OF IMAGE POLITICS

There is a baffling paradox in contemporary international relations that can hardly escape the

attention of discerning observers. Technological abundance in the availability and use of telecommunication facilities, media and channels is coupled increasingly with dramatic events and processes (such as the Vietnam War, the Hostage Crisis, and to a lesser degree perhaps, the North-South Dialogue leading to the Brandt [1980] and MacBride [1980] Reports) in which rational discourse is often drowned in a flood of abusive words, images and noise that limit the possibilities for meaningful negotiation of international conflicts. The mass media and its practitioners are held by some at least partially responsible for this state of affairs, while others point to the constructive role that the media can and have played in direct and unadulterated reportage of international events and in providing channels of international communication hitherto unknown and explored.

What is the real role of telecommunications services in international conflict? Traditional realist theories of international relations consider the struggle for power in terms of national interest as the dominant factor in the conduct of nations. (Morgenthau, 1978) The international system is considered as an example, par excellence, of a primitive political community still largely devoid of the essential properties of sovereignty. Fragility of a weak world moral and political consensus, the low level of development of methods of rule making, rule adjudication, and rule enforcement, characterize the international system. The system is thus considered far more prone to the rule of violence than its domestic constituent parts. The realist theorists have maintained therefore that the pursuit of a policy of naked national interest to achieve a system of balance of power is a far more effective guarantee of peace than "idealist" pursuits of human

rights, social justice, national self-determination, world disarmament, etc. In such views, the media as well as all the ideational paraphernalia of a realistic foreign policy (i.e., public opinion, diplomacy, ideology and propaganda, morality, etc.) are subordinated to the considerations of power politics.

In the meantime, however, the realist school itself has undergone some changes of mind. In the words of one eminent theorist of the school, "it is perhaps no exaggeration to say that today half of power politics consists of 'image making.' With the rising importance of publics in foreign affairs, image making has steadily increased. Today, hardly anything remains in the open conduct of foreign policy that does not have a propaganda or public relations aspect, aiming at presenting a favorable image to allies, opponents, neutrals, and last but not least, one's own domestic audiences. (Hertz, 1981:187) A vivid and timely illustration of this point is perhaps President Reagan's refusal in the Ottawa Summit of July, 1981, to be photographed in the official portrait next to either Prime Minister Margaret Thatcher of U.K. or President Francois Mitterand of France. For the media-conscious U.S. President, it was considered undesirable to be either compared or contrasted with the other two leaders whose domestic policies represented parallel and opposite ideological views.

It is the contention of this essay that in the last 25 years, at least three major technological, socioeconomic and political forces have altered the structure of the international system to such a degree that even a "realistic" view would have to consider the vital role that the apparatus of image making are playing in international relations. We may identify these forces as follows.

First, the accelerating technological explosion in the field of communications of which the revolutions in satellite communication and microprocessing techniques (the chip) represent the two most dramatic illustrations, have both universalized and personalized world communication. (Dordick et al., 1981) The convergence of six somewhat separately developed technologies (i.e., printing, broadcasting, point-to-point telecommunications, computers, satellites and micro-processors) into a single technological revolution has been characterized by some as a Second Industrial Revolution. The accelerating processes of miniaturization and mass production and consumption of information and communication goods (from transistor radio/tape/video to pocket calculators and home/office word processors) has led others to hail the phenomenon as the coming of "Post-Industrial Society" and the "Age of Information." (Bell, 1973; Porat, 1977; Kumar, 1978; Dordick et al., 1981; Gerbner et al., 1981) Without necessarily accepting such claims, we may readily recognize that the traditional notions of national sovereignty are seriously undermined by the ability of the Super-Powers and Transnational Corporations to conduct constant

surveillance of national resources (both subterranean and suboceanic), military personnel movements, changing patterns in weather and crops, and transborder information data flows. The domination of world news gathering and dissemination systems as well as of the cultural industries (printing, movies, audio-video hardware and software, etc.) by a few countries and companies has also created real anxieties about preservation of cultural autonomy and national identity in smaller countries. (Nordenstreng & Schiller, 1979) Thanks to the extraordinary achievements in telecommunications, however, it is now technically possible for one person to speak directly and simultaneously to untold millions of people all over the world, while it is also becoming increasingly possible for millions of individuals to reach millions of others personally and instantaneously. The new communications technologies have thus exhibited both centralizing ("the global village") as well as fragmenting (the global chaos) potentialities. If their centralizing effects have served as a primary force, it is because the world system is still organized around nation-states and transnational corporations which are primarily interested in control rather than dissemination of information. There is also the problem of a cultural lag: the international system has not yet fully developed the authentic supranational channels and institutions which the new communication technologies make possible.

On the contrary, however, a second set of forces have been set into motion by the democratizing pressures of a worldwide revolutionary process that owes its origins in no small measure to the introduction of the mass media (from printing onwards). The exposure to mass media through the print and the audio-visual signals has created rising levels of expectation, envy, and frustration. While the big media (national newspapers, broadcasting, satellites, central data processing) have provided channels for elite communication, decision making, dissemination and legitimation of their views and interests, the small media (small and underground press, xeroxing, mimeographing, transistor radio and tape, etc.) have facilitated the channels of communication among a diversity of disenfranchised groups. The pluralization of epistemic communities in a democratization process have thus created competing claims for identity and political community that utilize the expanding channels for communication. Thanks to the power of the new media, such groups as the Islamic revolutionaries in Iran, the Irish Republican Party, the Kurds, and the Palestinians can attract the attention of the world to their own cause for sustained periods. (Tehrani, 1979a & b, 1980) The polarization of world politics into super-power rivalries is thus countered by its fragmentation into a series of essentially local conflicts that nevertheless manage to attract and sometimes divide world public opinion.

In the meantime, however, a third set of forces have been at work to provide some measure of the

integration of the world community. While the media have served as channels for the conduct of world ideological conflict as well as of consensus generation, crises of worldwide dimension have also contributed to the emergence of a "new tribe" of world citizens and world organizations that transcend national loyalties and boundaries. The possibility of an accidental or designed nuclear war of total annihilation, the changing balance between world population and world resources, and increasing North-South cleavage--each threaten to unleash untold suffering and human conflict in the coming decades. International communication, broadly conceived to include not only the mass media but also the elite, prestige, trade and scientific media as well as channels such as the UN system, international commission (e.g., MacBride and Brandt), scientific and professional associations, world conferences, tourism and world travel as well as travelling journalists, etc., all seem to have contributed their share to the emergence of a new "world consciousness."

Telecommunications seem to have thus contributed to the conduct of international relations in basically three different ways: (1) by providing expanding channels of communication, (2) by mobilizing support for opposition to certain issues of international significance, and (3) by creating new international interest groups to bring pressure upon the existing machineries of nation-states, transnational corporation and intergovernmental organizations.

II. HOSTAGES TO IMAGES: SOME HISTORICAL EVIDENCE

The confluence of "image politics" and "power politics" in international relations is perhaps nowhere best illustrated than in the Iranian Hostage Crisis of November 4, 1979-January 20, 1981. However, this crisis is not alone in contemporary affairs to suggest the increasing role of image and image-making in international politics. Sadat's trip to Jerusalem was not only a symbolic gesture of his peaceful intentions but also a powerful bid for U.S. and European public opinion support. Maintaining credibility was the chief aim in later Vietnam policy in spite of the bankruptcy of the war effort. The wish not to seem untrustworthy to allies has been, in fact, a continuing theme in most Great Power politics. The U.S. support of the Shah almost to the end, or the Portuguese, as NATO allies, to their end in Africa. "Or," as Hertz puts it, "consider the incursion of Vietnam by China. There was no real substantive conflict there. But China felt it had to preserve its image as a power through a show of force meant to wipe out any adverse reflection on its power that might have been created by the Vietnamese overthrow of the China backed Pol Pot regime in Cambodia. Suppose the Soviets, to wipe out the adverse image of their power, created by the Chinese invasion of their Vietnam ally, in turn found it necessary to 'incurse' into China, whereupon the Americans, to preserve their image

as a reliable friend of Deng's China, had taken measures against the Soviet Union." (Hertz, 1981:187)

In image politics, the media plays a central and sometimes autonomous role. However, as projected images (of "strong and unwavering allies," "determined and relentless revolutionaries," "reasonable and peace-loving states") are aggrandized by the media into larger than life mental pictures, media manipulation becomes far more difficult. Every image, so to speak, creates its own reality. Certain postures which were perhaps valuable at certain stages of a conflict become impediments at certain other stages. Frozen images can prove therefore as serious an obstacle to negotiations as real conflicts of interest. Conversely, when the media manages to break through the barriers of control and censorship and shows the real state of affairs as one of confusion of facts and ambivalence of minds, as in the Vietnam War or the Iranian Hostage Crisis, then international conflict assumes a fluidity of form and complexity of substance beyond the relatively simpler calculations of power and rational interest. A diversity of domestic and international audiences, each with their own claims and interests, come into play and blur the traditional boundaries between domestic and international politics.

Following in the footsteps of Jurgen Habermas (1971), John Hertz (1981), and Richard Ashley (1981), we may argue that the media serve three basically different and often contradictory cognitive interest in international conflict situations: (1)

1. National solidarity interests. This corresponds to Habermas's "practical cognitive interest," an interest in knowledge as a basis for furthering mutual intersubjective understanding. The mass media have provided powerful means in the hands of governments for furthering national integration and national solidarity on issues of international conflict. The media in this role concentrate mostly on myths, symbols and rituals that have emerged out of a particular historical and cultural tradition. They provide therefore a cognition toward the development of interpretations that make possible the orientations of action within common traditions. In this sense, the uses of the media in international conflict are primarily directed toward domestic audiences.

2. National or Sub-national Instrumental Interest. This corresponds to Habermas's category of "technical cognitive interest, an interest in knowledge as a basis for extending control over objects in the subject's environment (possibly including strategic dominance over other human beings)." (Ashley, 1981:208) The media in this role concentrate on the legitimation of material or strategic interests (e.g., the price and security of oil supplies, the missile gaps, etc.) and employ images of power rivalries among nations and corporate groupings that are inherently in con-

flict over the ownership, control and manipulation of world resources.

3. Global Community Interests. This corresponds to Habermas's "emancipatory cognitive interest, an interest in securing freedom from 'hypothesized forces' and conditions of distorted communication (e.g., ideology)." (Ashley, 1981:208) The function of the media in this role is rooted in the human capacities for the communicative exercise of reflective reason in light of needs, knowledge and rules. In the international arena, the media have to break through the over-powering needs of national solidarity and instrumental manipulation in conflict situations and focus on the long-term strategic interests of a global community that is increasingly threatened by what Waltz aptly calls the four p's of global self-destruction—pollution, poverty, population and (nuclear) proliferation. (Waltz, 1979:139)

The Iranian Hostage Crisis, so rich and multifaceted in its global implications, lends itself particularly well to an analysis along the foregoing theoretical framework. At every major point in the decision-making process, the media managed to reveal the underlying interests of the parties involved in the conflict and played thereby an important role in the evolution and resolution of the drama. On the other hand, the crisis became a "Media Event" on both sides (in Iran as well as the United States) with its own autonomous political and commercial "rating" playing a crucial role in the domestic politics of both nations as well as in inter-media rivalries. (2) The "image" of the hostages rather than their reality came thus to serve the threefold interests of both nations for mobilizing national solidarity at critical junctures in their histories, catering to the instrumental control of the other's behavior, and in the end, acknowledging their common and global strategic interests in the sanctity of diplomatic immunity, preservation of innocent human lives, and de-escalation of a local conflict that threatened to turn into a larger conflict detrimental to the interests of all concerned. Let us examine the drama in greater detail and at the major points in its unfolding. (3) (See Table 1)

Backdrop. The overthrow of the Shah's regime in Iran should be considered in the light of the struggles of a small nation of some 35 million people for some 180 years to assert its independence against considerable geopolitical odds in a strategically and economically important region of the world. American involvement in Iran was, on the other hand, motivated partly by strategic and economic interest and partly by a postwar ideology of liberal internationalism/ interventionism. However, the role of the United States in Iran underwent a major shift when in the CIA-sponsored coup d'etat of 1953, Dr. Mosaddeq's liberal democratic government was replaced by the Shah's authoritarian regime. The United States became increasingly identified with the Shah's regime and its excesses, while the Shah came to look to the

United States as his main ally and benefactor. The Iranian revolution fundamentally altered this set of relationships between the two countries, but the images of continued U.S. domination and Iranian dependency lingered on. The Hostage Crisis took place in the context of these historical circumstances. It revived the memories of August 1953 when the Shah fled the country only to be returned to power in four days by what seemed to be outside forces. Under President Carter's Administration, however, the United States was still emerging out of a post-Vietnam War period of withdrawal and retrenchment. The crisis thus lent itself to profound misperceptions and symbolic uses on both sides, while it provided the media with an insuperable human drama endowed with a beginning, a middle and an end—tragic or triumphal.

Enter the Shah. Following the overthrow of the Shah, in February 1979, the debate on U.S. policy in Iran centered on whether or not to give refuge to the fallen and wandering monarch. Loyalty to an old and faithful ally clearly called for not only his admission but also assistance to regain his throne; this was considered as an "American tradition" upon which national solidarity interests rested. However, U.S. instrumental interests dictated otherwise. The revolution in Iran was by all accounts considered a popular uprising; it manifested strong religious and anti-communist tendencies; it could be therefore manipulated to the advantage of U.S. strategic interests; a refuge to the Shah would have thoroughly undermined the U.S. position with the new regime; therefore, U.S. diplomatic dispatchers from Tehran as well as policy analysis in Washington recommended against his admission. But, the medical diagnosis of his terminal cancer changed the picture totally. United States global interests in human rights, considered as a corner stone of Carter's foreign policy, combined with pressures of the "old boy" network of Henry Kissinger, David Rockefeller, and John J. McCloy to gain the Shah finally an admission into the United States for medical treatment. This decision was made against the explicit warnings of the U.S. embassy in Tehran which had been occupied on February 14, 1979, by revolutionary militants for a few hours. President Carter's fateful decision seems to have served three different symbolic functions at the time: (1) to soothe the guilt feelings of having let down an ally, (2) to placate those who were posing a question on "who lost Iran," and (3) to project an image of a president who is sensitive to human rights while tough on issues of national interest.

The Siege of Embassy. On November 4, 1979, the U.S. embassy in Tehran was seized by a group of so-called Islamic student revolutionaries as a sit-in to protest against the Shah's admission into the United States. In retrospect, the seizure of the embassy seems to have served also three different symbolic functions in Iran's post-revolutionary politics. First, revolutionary

Table 1. The Hostage Crisis: A Schematic View of Symbolic Uses in International Politics

Cognitive Interests Points of Decision	National Solidarity Interests	National/Subnational Instrumental Interests	Global Community Interests
Admission of the Shah into the U.S., October 22, 1979	<u>USA</u> To alleviate guilt feelings about letting down an ally.	<u>USA</u> To placate "old boy" network of interests posing the question of "who lost Iran."	<u>USA</u> To fulfill human rights claims in providing medical treatment to a dying man.
Seizure of the U.S. Embassy in Tehran, November 4, 1979	<u>IRAN</u> To mobilize sagging public enthusiasm for the revolutionary cause.	<u>IRAN</u> To embarrass and unseat Prime Minister Bazargan's government and his liberal-secular, moderate faction from power.	<u>IRAN</u> To dramatize Iranian grievances against the Shah and U.S. imperialism and appeal for world public opinion support.
Abortive Negotiations, November 4, 1979- April 11, 1980	<u>IRAN</u> To resolve an embarrass- ing issue (for the secular faction); to continue using the issue for national solidarity (the clerical faction). <u>USA</u> To release the hostages without resort to military means.	<u>IRAN</u> To reverse its own decline (the secular faction); to undermine the credibility of the secular faction (the clerical faction). <u>USA</u> To regain influence in a vital area without losing face.	<u>IRAN</u> To appear to be standard bearer of a just cause (bringing justice to a tyrant) without damage to innocent lives. <u>USA</u> To defend the basic rules of international conduct.

The Rescue Attempt, April 24, 1980	<u>USA</u> To assert its military power without endangering innocent lives or world conflict.	<u>USA</u> To improve the image of a weak president in an election year.	<u>USA</u> To project an image of a strong yet restrained Super-Power.
Resumption of Negotiations, September 9, 1980- January 20, 1981	<u>IRAN</u> To dispose of an issue that had substantially lost its unifying value after the Iraqi invasion. <u>USA</u> To resume efforts for a peaceful settlement of a national humiliation.	<u>IRAN</u> To relieve the clerical faction of accusations of irresponsibility leveled by the secular faction and to prove who the real power is in Iran. <u>USA</u> To achieve a settlement acceptable to national as well as parochial financial interests before the end of Carter's term.	<u>IRAN</u> To prove Iranian goodwill and expose U.S. financial interests. <u>USA</u> To achieve world approval in a just cause.
Final Settlement and Catharsis, January 20, 1981	<u>USA</u> Joy of homecoming of captive sons and daughters and release from a national ordeal symbolic of America's declining powers. <u>IRAN</u> Shift from an increasingly costly and divisive issue to another unifying issue for national solidarity, i.e., the war against Iraq.	<u>USA</u> The continuity of U.S. foreign policy despite the change of administrations with two different outlooks and approaches--Reagan's tough words actually helping Carter's conciliatory approach. <u>IRAN</u> Projection of the new, clerically controlled government as the real center of power in Iran.	<u>USA</u> The honoring of U.S. commitments by the new administration and refusal to engage in reprisals. <u>IRAN</u> Projection of the revolutionary government as responsible and responsive to global Third World community interests and sentiments.

enthusiasm was beginning to ebb in the face of mounting economic and political difficulties when protests against the Shah's admission into the United States and demands for his immediate return to Iran for a trial presented themselves. There is evidence to believe that both the student militants and their mentors were surprised by the degree of spontaneous national support they received for the seizure of the embassy. The sit-in thus turned into a siege to galvanize further support and serve revolutionary solidarity interests. Secondly, however, the seizure of the embassy had come at a time that the conflict between the liberal moderates led by Prime Minister Mehdi Bazargan and the revolutionary radicals led by Ayatollah Beheshti as well as a myriad of leftist political parties and groups had reached a breaking point. A week earlier, Bazargan and his Foreign Minister Yazdi had met U.S. national security adviser Zbigniew Brzezinski in Algiers to discuss an improvement of U.S.-Iranian relations. The seizure of the embassy served therefore also an instrumental interest in a virtual coup d'etat against Bazargan's government, which had to resign under the circumstances. Thus, for a while at least, opposition to the clerical leadership was successfully silenced by a national frenzy of emotions against the crimes of the Shah and U.S. imperialism. The seizure of the embassy provided both the excuse and the "evidence" in the shredded files to intimidate and eliminate whoever was regarded as liberal, moderate, or Westernizer. Third and finally, the siege of the embassy contained elements of enormous international symbolic significance for the revolutionaries. It served to dramatize the cause of Iran in international fora as well as to "emancipate" the oppressed everywhere from fear of U.S. omnipotence. The release of 13 women and black among the hostages, the organization of an international conference in Tehran to unmask the crimes of the Shah and U.S. imperialism, the advertising of Ayatollah Khomeini's letter to the Pope in some major Western newspapers, the friendly reception given to Third World journalists and mediators, all symbolized efforts to mobilize world public opinion on Iran's behalf. Although this was successful to a degree among those nations who had suffered colonial domination, gleeful in a vicarious satisfaction of the humiliation of the United States, the international state-system as a whole could not accept the violation of its most necessary rules of conduct, i.e., the protection and immunity of diplomats.

Abortive Negotiations. In the first round of negotiations for the release of the hostages, three factors worked against real progress: U.S. misperceptions on the locus of power in Iran, Iranian misperceptions of U.S. public opinion response to the fate of the hostages, and the intense symbolic uses made of the issue in the domestic politics of the two countries. Throughout this first round, the U.S. continued to deal primarily with the wrong faction, i.e., the liberal secular moderates (Bazargan, Yazdi,

Bani-Sadr, Ghotbzadeh) who were neither for hostage-taking nor had the power to release them. In fact, U.S. admission of the Shah into the United States had been partly encouraged by assurances from Prime Minister Bazargan and his Foreign Minister Yazdi for the protection of the American embassy and personnel. While Bani-Sadr and Ghotbzadeh were also against hostage-taking as detrimental to the good name of Islam and the revolution, they could not have afforded to be perceived as siding with the "U.S. imperialists" in the domestic power struggle. However, once the leftists and clerical factions had realized the enormous symbolic uses of the hostages in unmasking and destroying the liberal "appeasers and lackeys of imperialism," the negotiations for their release were continually and effectively undermined. This was aided in part also by the issue of the hostages becoming an important symbolic factor in U.S. presidential elections and receiving an unprecedented media attention. In retrospect, President Carter has accepted that some benign neglect for the hostages issue might have actually helped to hasten their release. (NYTM, 1981)

The series of bizarre encounters and plans which were engaged in by a variety of world personalities (Waldheim, M'Bowe, MacBride, Yasir Arafat) as well as actual negotiators (Jody Powell, Ghotbzadeh, and their go-betweens Christian Bourguet and Hector Villalon)—all came to naught with one significant exception. In a personal intervention with the Ayatollah, PLO leader Yasir Arafat is credited to have obtained the release of the first 13 black and women hostages only 16 days after their capture. Neither the source nor the symbolic significance of this act of "clemency" should have been lost on the negotiators.

The Rescue Attempt. Having almost reached what appeared to have been a negotiating impasse, President Carter on April 11, 1980, decided to embark on a plan to rescue the hostages. The mission was actually undertaken on April 24; it was however, cancelled on April 25 in a grim scene of death and destruction at an airstrip, code named Desert One, in a remote section of Iran. "The full story of the aborted mission may not be known for years, or even decades," according to The New York Times military analyst Drew Middleton (NYTM, 1981:103) The rescue mission served again the same three basic symbolic functions. First, it came at a time that the crisis had become an American obsession in which the media and the President had managed to make it a center-piece of national attention, while the series of fruitless attempts at a negotiated settlement left the public fully frustrated at U.S. impotence. The rescue attempt, half-hearted as it seems in retrospect, may be therefore interpreted as an effort by President Carter to assert the national will and to regain national solidarity behind his leadership. Secondly, however, the mission came at a time that President Carter's popularity and campaign efforts were facing some serious setbacks.

While earlier in the crisis, his presidential posture in defense of the hostages' lives had served him well against Senator Edward Kennedy and others in de-politicizing the issue, his inability to solve it was becoming a symbol of his weaknesses in foreign policy. Although the mission cost him the services of a respected Secretary of State, Cyrus Vance, he came out of this crisis as a President willing to use force when necessary. Finally, however, the strict limitations he had imposed on the use of this force served to symbolize his intentions to contain the conflict, while ensuring possibly the failure of the mission right from the start.

Resumption of Negotiations. Negotiations were resumed for a second time only at the initiation of the newly constituted Iranian Majlis (parliament) and government, which were both controlled by the radical clerics. For the clerics, the hostages had by now served their threefold symbolic functions of whipping up sagging national enthusiasm, undermining the position of the secular liberals and mobilizing world public opinion in support for the Iranian cause. In fact, the Iraqi invasion of September 22, 1980, dwarfed the hostage issue as a rallying cry, while it brought home to the clerical faction the liberals' claims that the issue was increasingly isolating Iran and making it vulnerable. In the negotiations which followed, the positions of the two sides shifted from symbolic to substantive issues, i.e., the release of the hostages in return for the return of Iranian assets frozen in the American and European banks. The complex settlement which was reached through the mediation efforts of Algeria had to reconcile Western Banking interests with Iran's desire to receive the full return of its assets. Iran's decision to pay off the entire \$3.67 billion in outstanding low-interest loans with Western banks, while setting aside another \$5.1 billion against American and European claims contributed to the financial settlement. The financial loss to Iran in this transaction was substantial. Iran thus gained little and paid heavily in political and economic terms, while the United States suffered in prestige and mental anguish.

The Catharsis. The tumultuous welcome the hostages received upon their return home symbolized in no uncertain terms the extraordinary meaning of this affair in recent United States history. However, it also underlined the symbiotic power of the media in combination with the presidency to focus on a single issue for 444 days to the detriment of most other domestic and international issues. Following in the wake of the humiliations of Vietnam and Watergate, the Hostage Crisis symbolized yet another facet of a weakening America. A national yearning to believe in itself seized upon the hostage crisis and its victims/heroes as symbols of traditional American virtues of quiet strength under stress. However, the crisis also presented a test case for the Carter presidency. As Steven Weisman has put it, "a president who had

risen to office because of his mastery of symbolism, achieving its height in his walk down Pennsylvania Avenue on Inauguration Day, met his fate in large measure because Iran had become a symbol of what American had come to dislike about their country—its seeming inability to get control of events and serve as the master of its fate." (NYTM, 1981:120) For this symbolism, President Carter has to share some of the responsibility along with the U.S. media which often act in consonance rather than dissonance with the presidency. In 1968, for instance, when 38 U.S. crew members aboard an intelligence ship *Pueblo* were seized by North Korea, the hostages were not made into a Media Event. "It is true," as George Ball points out, "They were naval personnel, but they were in much worse shape, because they were tortured, and they were kept for nearly a year." (NYTM, 1981:117) Subsequent to their release, the media once again responded to the presidency when it relegated the hostages to its back pages. As in the case of Vietnam perhaps, the nation also wished to forget and opted for a collective amnesia. The symbiotic relation between the presidency and the media, particularly on issues of foreign policy, is well brought out by the comments of Jeff Gralnick, executive producer of ABC's "World News Tonight:"

"If the government had nothing public to say, except that it would run things as if no crisis existed and we will negotiate quietly until they are released, the media would not have been able to do anything with the Iran story." (NYTM, 1981:117)

III. CONCLUSION

This essay does not argue for a mediacentric view of contemporary relations. However, it suggests that a combination of three circumstances has created an extraordinary role for the media and the "image politics" that it generates. The rapid and worldwide expansion of telecommunication facilities leading to the universalization and personalization of international communication, the mobilization of untold millions into the position of actors onto the historical scene, and the gradual creation of transnational channels of communication (international news agencies, professional and scientific associations, international fora, etc.) have created multiple cross-national actors and audiences and have thus blurred the traditional boundaries between domestic and international politics. Thus, for every public act a statesman undertakes today, he must calculate its substantive as well as symbolic significance in relation to a multiple of interests and audiences.

"For international or world public opinion to develop as a political force," W. Phillips Davison has proposed, "three requirements must be fulfilled: People in several countries must give their attention to a given issue; they must have sufficient means of interacting so that common and

mutually reinforcing attitudes can form; and there must be some mechanism through which shared attitudes can be translated into action" (Davison, 1973:874) If we accept Davison's three-fold criteria, the Hostage Crisis illustrates how under certain circumstances and with respect to certain emotionally-charged issues (threats of nuclear war, revolutions, acts of terrorism, etc.), image politics can become a factor of some autonomous importance. The Hostage Crisis received relentless international attention and particularly in the two countries involved; the worldwide networks of travel, the press, and electronic media provided sufficient means of interaction among elements of the two nations (Iranian students and exiles in the U.S., U.S. clergymen, journalists and congressmen in Iran) so that attitudes of dislike for the support of the Shah's dictatorship and disfavor for hostage taking tactics gradually evolved in the two countries; and, finally, these sentiments were translated into a settlement that resolved the crisis. However, the settlement did not come until the two sides had exhausted the symbolic uses of the issue in their own domestic politics.

For the United States, as a Super-Power, the Hostage Crisis marked also a turning point in its climate of opinion—from aversion to war and foreign entanglements born out of Korean and Vietnam experiences to one of support for assertiveness and military preparedness. As Yankelovich and Kaagan argue on the basis of their public opinion polls in 1980, "Americans have become surprisingly explicit about how the United States should seek to regain control of its destiny, and in the context of the disquieting realities of the 1980s, these ideas create a new, different and complex foreign policy mandate for the Reagan presidency. The national pride has been deeply wounded; Americans are fiercely determined to restore our honor and respect abroad. This outlook makes it easy for the Reagan Administration to win support for bold, assertive initiative, but much more difficult to shape consensus behind policies that involve compromise, subtlety, patience, restrained gestures, prior consultation with allies, and the deft geopolitical maneuvering that is required when one is no longer the world's preeminent locus of military and economic power." (Yankelovich & Kaagan, 1981:696-7) One consequence of this has been the dramatic rise in the defense budget; another will be renewed efforts by the Reagan Administration towards what one author has called "public diplomacy"—the dissemination of America's message abroad—expected to "become Washington's major growth industry over the coming four years." (Adelman, 1981:913)

For Iran, as a small power in grips of a revolutionary upheaval, the Hostage Crisis suggested once again its weaknesses and vulnerability to international political, economic and public opinion pressures. Despite its doggedness, the clerical leadership in Iran finally failed to achieve any of its original objectives—the return

of the Shah and his wealth, a public apology from the United States for its past interferences in Iran, and world sympathy for its cause. Despite its seeming resilience to outside opinion, the Iranian leadership had also to bow in the end to the pressures which were exerted for the freedom of the hostages from foes as well as friends. World public opinion bias in favor of diplomatic immunity had also, in the meantime, undermined the initial domestic support in Iran for hostage taking.

Beyond these considerations, this essay also suggests the threats as well as the promises that the new telecommunication facilities offer for the conduct of international relations. The threats are very real: the menace of unreality. What Daniel J. Boorstin (1975) has said of America is now perhaps true for an increasingly "Americanized" world: "We risk being the first people in history to have been able to make their illusions so vivid, so persuasive, so 'realistic,' that they can live in them. We are the most illusioned people on earth. Yet we dare not become disillusioned, because our illusions are the very house in which we live; they are our news, our heroes, our adventure, our forms of art, our very existence." The Iranian people were no less victimized by this particular pathology than the Americans during the hostage crises.

On the other hand, the new telecommunications facilities provide unprecedented facilities for the construction of those channels of genuine transnational communication that could give global interests and world community an extraordinary opportunity for development. For this task, professional communicators (politicians, artists, scientists, journalists, publicists, teachers, clergy) have both a special training and a special obligation.

FOOTNOTES

- (1) My choice of terminology here, different from those of Habermas and Ashley, is more with a view to intelligibility of concepts than any philosophical justifications. The three layers of interest discussed here correspond perhaps to the philosophical distinctions between the three types of reason—practical, instrumental and reflective. (critical/dialectical)
- (2) The rivalry of the American television networks for access, for instance, provided the Iranian authorities not only with some political leverage but also some commercial revenues.
- (3) For an excellent review of the case, see The New York Times Magazine's Special Issue, Spring, 1981.

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Drums and Satellites: The Semantics of "Communication"

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Abstract

This paper presents the notion that we are using the concept of "communication" to cover processes that are often antithetical, and that this confusion does not favour the smaller nations.

For several decades now we have been confronted by a "communications explosion" which allegedly has changed the history of our lives. The faithful affirm that the biggest industry in the dominant countries (the "First World", one would imagine) is the communication industry, and that no industry has the impact this one activity does have. The lack of communication is supposedly at the base of all evil, from Pearl Harbor to Auschwitz and compensating this good communication will right all wrongs.

All of this does have a theological ring to it, as we are confronted by the ultimate tool, or philosophy, which cannot admit proof to the contrary. When defining, communication becomes all-embracing, and its study encompasses from the gestures employed by a colony of ants or the ritual dances of the honey bees to Archie Bunker's antics. But when one scholar wants better communication between isolated communities in the Pacific Basin, the Pacific thinks about alienation.

The point I am trying to make is that we are trying to cover too many different concepts with but one umbrella, and that many of these concepts, which use the same name, are not only dissimilar, but antithetical. We are using "communication" to refer to the use of satellites as well as to the use of murals or protest songs. This makes for an impressive breadth of field, but detracts from both scientific rigour and social usefulness.

I would like to see a classification of what we define as communication in which the differences are stressed and not the similarities, and in which the *cui bonum* question is asked. We study communications as if it were a scientific or technological phenomenon that is relevant to the inhabitants of some planet around Proxima Centauris, when in fact they are a part of our everyday experience, and exist only within a certain social and economic context, in which they serve certain interests, certain groups, certain goals.

It is meaningless to say that the uses of drums to communicate the path of a herd to the hunters in some Amazonian forest are essentially the same as the uses of *Intelsat*. The very differences in size, that is to say, in quantity, make for a

different quality. The satellite is not simply an extension of the mouth and of the ear, it is a completely different concept, at least socially. The confusion of both concepts is dangerous, as it means a misunderstanding of the power of the new technology, which has rules of its own, as well as rulers of its own. One unprovable question is of course the assumption that the confusion is brought about by those who stand to profit by it, by utilizing the concepts indiscriminately and thus making it impossible to see the real issue, i.e.: the concentration of power, through the technologies of this particular kind of communication, in the hands of small groups that are outside the social reality of the country, or group, at which the new technology is directed.

The very emergence, or imposition, of the new technology, makes the traditional forms of communication obsolete. The reasoning does not go to maintain that communication is being replaced by satellites, or by television, or by any other technology. The rationale behind it is that it is this same communication which has existed forever which continues, but is being converted into something better, and more efficient. Thus all dissonance is avoided and what we might call human communication is slowly (in fact rather quickly) abandoned and forgotten by a much more powerful medium (which is certainly not the message, but rather the voice of the owners of the message).

This is, as I see it, a description of a process, and not an ethical indictment (a truly scientific mind is impervious to such intangibles as ethics or the ultimate uses of science and technology, gas is gas, an atom is splicable, the logistics for the elimination of millions of people are an interesting exercise in statistics and ovens). But I should like to study some of the ethical-political implications, after trying to conceptualize and diagram the differences between communication and communication.

In communication the ultimate decision is left to the receiver. In manipulation the decision is already made by the transmitter, who in reality leaves no liberty to the receiver (if we consider the liberty of decision in a context of social reality, and not just as a metaphysical possibility).

We must try to understand any process within given social and economic contexts. As long as communication is in the hands of individuals, whose power to communicate is not infinitely superior to that of the receivers who are other individuals, these receivers can control it.

As soon as communications, or the means to start them, fall in the hands of non-individuals, corporations or representatives of huge interests, with means that are immeasurably superior to those of the individual, the individual cannot control it. As most studies have proved, we do not have the capacity to turn our TV sets off, of not reading our national newspapers, of avoiding the landslide of information which the media are throwing at us. And our children most certainly do not have it; no studies are needed to demonstrate this fact (although many studies are needed to demonstrate the contrary, thus favouring the controllers of the media, legitimized through academic mumbo-jumbo).

We must distinguish between "communicate with," and "communicate to." When we communicate to we take from the receiver the capacity to answer. One-way communication is not communication, it is manipulation or giving orders; pure information is not communication, when the receiver has no capacity of inquiring further, or of answering. As technical complications grow, so does the separation of the communicator from the receivers, who have less and less possibilities of giving feedback to the system. We find the paradox that the communications explosion, which is in fact an explosion first of pure machinery, and then of electronics, instead of augmenting the capacity of audiences to communicate makes it less. More and more information escapes the control of the audiences, who often receive the news from their neighbouring town through a long loop that goes from Rarotonga to Suva to New York and eventually back to Rarotonga.

Social and Policy Aspects of Basic Telecommunications Services

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The problem word is "basic." What is basic telecommunications services? How do you decide what is basic?

that, curiously, seem to reflect the nation's culture and its history and roots.

Are basic telecommunications services a telephone with the capacity to reach every telephone in a neighborhood, city, state, nation or world-wide? The Communications Act of 1934 calls for "... communication by wire and radio so as to make available, so far as possible, to all people of the United States a rapid, efficient, Nation-wide and world-wide wire and radio communication services"

Is it a voice communication only? The Communication Act continues "... with adequate facilities at reasonable charges for the purpose of the national defense, for the purpose of promoting safety of life and property through the use of wire and radio communication . . ." The State of California has interpreted this to include services for the hearing impaired and has established an additional \$0.15 per month tariff for the provision of "... Communications Services for the Deaf."

In the future, will basic telecommunications services include access to information libraries? How many and for how long and at what charges?

In the future will basic telecommunications services include cable television services? Will it include interactive services and the reception of all satellite signals, including those of the direct broadcast satellite?

When are the charges for basic telecommunications services deemed to be too high? In California, the State has found that the charges for basic service for the elderly are too high and have established a lower "life-line" tariff.

Is there a universal basic telecommunications service for all people in all nations? Is this the operational question that must be resolved in order to implement a right to communicate?

How does one determine what basic telecommunications services are to be? To date social and behavioral research has only begun to understand the impact of the mass media. The telephone is still somewhat of a mystery and the political as well as social effects of cable, the small media and the satellite have yet to be adequately addressed.

National policies are driven by economics and politics. If left to the "magic of the marketplace" a "basic" level will be reached. But will it meet human needs? Clearly, this has not been the case in many states in the U.S. The courts continue to interpret "basic." The multi-level court system in the U.S. seems to create a marketplace of decisions

The Social Benefits of Good Economical
Communications with Isolated Areas

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Scattered over a vast area of sea covering two million square kilometers are the fifteen islands in the Cook Group. The Northern Group islands, Manihiki, Tukae, Rakahanga, Pennyhu, Lekankua, Pukapuka, Nassau, and Sumarrau, are the furthest from Rarotonga the capital of the Cook Islands.

The normal inter-island ships call at these islands once every two months to take mail and store goods and also passengers and in return bring in produce such as copra, pearlshells, pearls, and handcraft for export.

Since 1978 shipping calls have been more frequent as a result of heavy subsidization by government for shipping services. If present arrangements are unable to be continued then shipping will revert to two or three calls a year as in the past.

The closest islands to Rarotonga are the Southern Group islands, namely Aitutaki, Atiu Mangaia, Mauke, Mitiaro, Palmerston, Manuae, and Lakutea. These islands export bananas, pineapples, some copra, oranges, taro and processed arrowroot. While Rarotonga exports processed citrus and pineapples as well as fresh fruit and vegetables which are airfreighted to New Zealand and American Samoa, there are also some small manufacturing industries in Rarotonga and a growing tourist industry.

Since World War II all islands have been connected with Rarotonga by radio telegraph services. However charges for telegrams have been high and the service slow. They have been more or less restricted to the business community.

In recent years radio telephone services have operated intermittently and expensively; too expensive for general use.

From the first day of January 1979, the Prime Minister's Department through its Scientific Research Division in conjunction with its PEACESAT Terminal, established an inter-island H.F. radio network which soon included 18 stations.

Using modern amateur radio equipment on allocated fixed frequencies operating from 12 volt batteries charged by photo voltaics and including selective calling units the whole network was established for \$30,000. Operating costs are low. The outer island units are operated by the govern'ts chief administrative officers as part of their normal duties.

The network provides free telephone communications for medical personnel, government officials,

voluntary community organizations, students doing correspondence courses and religious bodies.

The Rarotonga Terminal uses the existing studio conferencing facilities and telephone patch capability of PEACESAT.

During a typical day three to four conferencing sessions and up to fifty telephone calls are handled as well as special sessions for members of parliament to discuss various problems with people of outer islands whom they represent.

In the event of any request to speak to the Prime Minister or the Prime Minister wishing to speak to anyone in the outer islands, this is done directly through the station on the Prime Minister's desk in his Office or through his home station.

The system has a very large social impact on all outer islands and has brought many benefits to them.

Every week medical emergencies arise in which case these take first and foremost priority over other traffic. The hospital in Rarotonga is contacted promptly for expert medical opinion and advice and if necessary aircraft or ships are diverted to bring the patient to Rarotonga for more advanced treatment than is available on the island. This service has undoubtedly, saved many lives.

The Agriculture Department has been the biggest user of the system. At the beginning of every week the department has conferences with outer islands staff to obtain the week's estimates of copra, pineapples, bananas and other agricultural production. These are in addition to daily point to point discussions on agricultural problems. These have speeded up and facilitated shipping schedules and local aircraft connections with both sea and air exports. This has resulted in much prompter payments to growers for their export produce. Lecturers from the agriculture department speedily introduce new and improved agricultural techniques. If any of their staff is travelling to the outer islands they are informed immediately over the system.

Education likewise hold conferences for Principals of Colleges, Science teachers, Maori Language, Secondary Curriculum, New Zealand School Certificate, Student Correspondence courses, and whenever vacancies occur for positions in education, advice of these is given immediately to teachers in the outer islands. When outer island teachers go on

overseas courses the education department discusses arrangements with teachers concerned.

Public Health Inspectors also have regular sessions with staff in the outer islands on daily problems. For example, when cargo is mishandled resulting in health hazard as when kerosene is spilled on sugar or flour, quick advice leads to rapid action. In the past such carelessness was seldom reported. When any epidemic of influenza affects any islands, the director of Public Health instructs preventive measures to be taken on other islands.

Public Health nurses also have regular sessions. During these, nurses are asked to give statistics on pre-natal and other cases under their care.

In the Northern Group when a diving machine breaks down and a part is needed measures are taken to see that it is sent on the first opportunity. On occasion a part ordered two hours before the sailing of a vessel was obtained and dispatched.

Recently the people of Manichiki and Tukao constructed new tennis courts assisted by a Social Development programme for the Northern Group. The Officer in charge said that what had been achieved in months would not previously have been achieved in several years, without the communications to facilitate the dispatch of the required material. These new tennis courts are very much used and appreciated on an atoll where sporting facilities have always been scarce.

News from Outer islands is regularly supplied to the broadcasting station on Rarotonga and on occasions outer-island people can be patched through on radio talk back shows. At Christmas time people on outer islands are able to give greetings live over Radio Cook Islands.

It is easier for government departments to recruit staff for service in the outer islands because with this communication system staff no longer feel isolated from their home islands.

Northern Group school children and teachers have participated in some PEACESAT programmes such as a Cross Cultural programme with Honolulu, Wellington, and Suva, and an exchange took place between Sunday School pupils in Rakahanga and Los Angeles. In these exchanges the H.F. radio network was patched into PEACESAT in which case our system becomes international. The local people refer to both systems as PEACESAT.

Now as a result of this communication people in remote islands have lost the feeling of isolation which existed in the past and have gained economically and socially and feel themselves as part of the whole country rather than as members of small isolated communities.

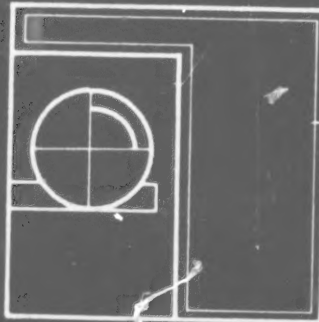
Although little mention has been made in this paper of the PEACESAT much has already been written about it. Its value to the social and

economic development of small countries over the past ten years has been outstanding.

For communication to serve the interests of development, such free or subsidized service is essential.



Tuesday, January 19:
Plenary Session
Developing
Telecommunications
Services



CASE STUDY :
THE CHANGING STRUCTURE
OF
ALASKAN TELECOMMUNICATIONS

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Abstract

Alaskan telecommunications facilities have been significantly expanded and improved since 1970. Telecommunications structure, within both government and industry, has become an issue in Alaska, and structural changes are occurring. In 1981, for example, the telecommunications functions of State government were reorganized. Telecommunications facilities have generally been moving from government to private ownership, but at least one major ownership issue remains.

(Film on telecommunications development in Alaska precedes presentation.)

As you have just seen, Alaska has, in the past decade, made considerable progress in telecommunications. In 1970 the large majority of Alaskan communities had no telephone service, no radio broadcast service, and no television broadcast service. Today virtually every community has telephone and radio broadcast service and many communities also have television. Most communities will have television broadcast service within the next two years. In many instances, advanced applications of telecommunications are also in use. Examples are electronic mail, computer assisted instruction and two separate audio conferencing networks.

In addition to the what of telecommunications, we are now beginning to give a great deal of consideration to the how of telecommunications. Where in the seventies we have been very much concerned with applications and facilities, we are beginning the eighties additionally concerned about the process of telecommunications development and the structure of our institutions and organizations. Areas of specific concern are:

- government structure
- industry structure
- economics

We are coming to realize that the process is as important as the product because it is the process that makes the product possible.

STATE GOVERNMENT STRUCTURE

Effective July 1, 1981, the telecommunications functions of the government of the State of Alaska have been reorganized and brought together under one department. These functions had previously been located within a number of different agencies. The reorganization, effected by Executive Order 50, reflected the need to:

- streamline the management of telecommunications
- institute a planning function
- Make assistance and coordination service available to State agencies

Under the reorganization, telecommunications functions are now located within the Department of Administration. Data processing functions are located in the same Department, and this is helpful where we have common problems. Further, we are well positioned for the merger of the communications and computer technologies.

Executive Order 50 placed all telecommunications under one person, a Deputy Commissioner of Administration. I hold that position and report to the Commissioner of Administration, whose responsibilities include a number of other areas. Reporting to me are two telecommunications divisions, an operations division and a planning division. The Alaska Public Broadcasting Commission is also attached to the Department of Administration.

Our operations division is responsible for the design, installation, and maintenance of essentially all telecommunications systems operated by State government. These systems range from data communications to State Trooper VHF radios to our statewide satellite television project. The division has 55 employees, with technicians located around our large state at a number of field locations.

The planning division is responsible for both short- and long-range planning, technical assistance to State agencies and other organizations, and coordination of State telecommunications functions. The division assists agencies and groups which have needs but don't quite know how to deal with them. It is available to provide assistance, suggest options, and develop cost figures.

The creation of the new planning division reflects our recognition of the need for a strong telecommunications planning function. This division will enable us to:

- effect needs assessment and facilities planning on a coordinated and unified basis
- implement a cost-effectiveness approach to planning
- anticipate both needs and problems, so that "firefighting" solutions can be minimized or eliminated

Establishment of these goals in Alaska is a major new development.

Within its first few months of operation, the planning division has started two major projects. One is a comprehensive plan for development of telecommunication services to State government. This includes telephone, data, audio and video services. The plan is to be complete in July 1982. The second is an examination of alternatives to State-funded rural television. This project, which is discussed further below, is scheduled for completion in early 1982. In addition, planning efforts in the area of instructional telecommunications and in the area of teleconferencing are scheduled to begin soon.

INDUSTRY STRUCTURE

As you know, we in the United States are now involved in deregulating portions of the telecommunications industry and in a general move in the direction of increased competition. Specifically, competition is on the rise in the telephone industry in the areas of terminal equipment and message toll (long distance) service. In broadcasting, alternatives to conventional television broadcasting are quickly becoming available (cable, direct broadcast, subscription television) and we have competition between the various technological delivery vehicles. Deregulation and competition are coming through the Commu-

nications Act Rewrite presently pending before Congress, through a number of actions by the Federal Communications Commission, and through the availability of new technology.

Although these changes are not unique to Alaska, they are of particular concern to us, especially in the area of telephone service. Unlike most of the United States, Alaska has a telephone network that is still in need of considerable expansion. Where most of the nation has achieved virtual universal availability of telephone service, Alaska has not yet reached this goal. Most of our communities have only one telephone each. The situation is improving rapidly, but proper economic conditions are necessary for continued improvement.

Rural telephony is, by nature, an economically marginal enterprise. Because subscriber densities are low, the cost of serving each subscriber is high. In our nation we have two mechanisms to offset this high cost, a low interest loan program administered by the Federal government, and the mechanism by which toll, or long distance, revenue is divided between carriers. These "toll settlements" provide a great deal of revenue to rural local exchange companies. Although low interest loans and toll settlements constitute subsidies of sorts, they appear justified by the national interest in universal service. It is beneficial to all citizens to have telephone access to all other citizens.

Both of the mechanisms which boost rural telephony are presently threatened. The low interest loan program may fall victim to Federal budget cuts, and toll settlements are likely to be reduced by deregulation. Deregulation of terminal equipment will remove such equipment from the base used to compute toll settlements, and in order to accommodate message toll competition, the toll settlements formulae will likely be changed. Both of these changes will reduce toll settlements.

One good solution to the toll settlements problem is contained in the Communications Act Rewrite presently pending before Congress. Called the "universal service pool," it is specifically designed to keep rates in high cost rural areas at reasonable levels. The universal service pool would be derived from a surcharge on toll charges nationwide and would be used for direct subsidy payments to high cost rural companies. The arrangement would accommodate toll competition and would also keep rural rates at reasonable levels.

Within our State telecommunications organization, we are continuously monitoring the status of changes at the Federal level. Where appropriate, we are attempting (often successfully) to influence those changes, for we are finding that we need to look after our own interests - no one will do it for us. The help of our Congressional delegation in Washington, D.C. has

been invaluable in this regard.

Another aspect of the changing industry structure in Alaskan telecommunications is reflected in the ownership of facilities. Since 1970 we have been moving away from government ownership and toward private ownership. Each major move in this direction has been the result of a decision by government.

Alaska's long distance telephone facilities were operated, until 1971, by the Alaska Communications System (ACS), an arm of the United States Air Force. The Air Force facilities had been constructed primarily to support radar stations located in Alaska but were used, in addition, to handle civilian telephone traffic. In January 1971, the ACS was purchased by RCA Alaska Communications, Inc. (RCA Alascom) as the result of an Air Force decision to divest itself of this system. In 1971, RCA took over all of the service the Air Force had provided to civilians in Alaska. RCA Alascom, which later was sold to Pacific Power and Light and is now known as Alascom, has developed and expanded the network in many ways, some of which you have seen in the film. The course of telecommunications development in the seventies has not always been smooth, and some of our progress has been the result of State action, but the development has happened with our telephone facilities, like those elsewhere in the United States, in private hands.

One of the rough spots occurred in 1975 when, after RCA's refusal to do so, the State decided to make a major commitment to satellite communications. The State purchased 100 small earth stations (4.5 meter antennae) for installation in Alaskan villages. RCA was given an opportunity to participate in the project and did eventually install all of the earth stations. The company has since operated and maintained the earth stations as a partner of the State. Ultimate ownership is to be decided by the Federal Communications Commission (FCC).

The State of Alaska has announced its intention not to seek final ownership, but, in the meantime, some of the local telephone companies serving Alaskan villages have filed for ownership of the earth stations within their service areas. Thus, Alascom and the local companies are now in contention for ownership, but, regardless of how the FCC decides the question, the earth stations will soon be in private hands. This outcome will be consistent with the structure of the telephone industry elsewhere in the United States.

Yet another ownership question is before us now. The State in 1976 initiated a Satellite Television project to provide television broadcast service to rural communities which, at that time, appeared to have no other possibility of receiving television service. The project now serves 94 communities, and

another 119 will have service by 1983. Under the project, the State owns and operates low power transmitters and receive-only earth stations in some communities. In other communities the State owns only the low power transmitters and purchases earth station services from Alascom. Programming is derived largely from the three national commercial television networks and from the public television network. As a result of these arrangements, the State is providing a service normally provided in the United States by the private sector. The project is possible only through the cooperation of the commercial networks and their Alaska affiliates. It is very popular in rural Alaska.

Recently, some purveyors of television service in rural Alaska, cable television and low power subscription television operators, have taken exception to State operation of rural television. Simply stated, these companies object to competition from the State. At the same time, these private sector operators are far from willing to provide service to all of the State's communities.

Thus, a very perplexing problem faces the State at this time. Is it possible to accommodate rural television service by the private sector and, at the same time, insure that service is available to all Alaskan citizens? The answer to this question may lie in direct satellite broadcast, in cable television, in low power subscription television, or in a combination of all three. The rural television question is the subject of a major effort within our telecommunication planning division. The work is scheduled for completion in early 1982.

CONCLUSION

We continue, in Alaska, to be interested in telecommunications facilities and applications, but we are equally concerned with the structure of our telecommunications institutions in both the public and private sector. In the public sector, we have taken a major step to improve our management and planning functions. State government is concerned with fulfillment of its own needs but also of public needs. We are moving telecommunications from the public to private sector to the extent compatible with service that is universally available to Alaskan citizens.

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Developing
Telecommunications
Services:
Emerging
Technology

DEVELOPMENT
OF
THE ANZCAN PROJECT

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ABSTRACT

With the rapid growth of telecommunications traffic in the Pacific Ocean region, consideration must be given for planning suitable trans-Pacific cable facilities in order to provide adequate media diversity for network flexibility and the desired growth of services. The paper reviews the existing facilities and describes the successful planning of a new major north-south trans-Pacific cable system linking Australia and New Zealand to Canada.

1. INTRODUCTION

During the last two decades, the field of international telecommunications has been characterized by a sustained growth in telephone traffic in all areas of the world. This has been accentuated by significant advances in transmission technology and by the rapid introduction of International Subscriber Dialing (ISD). Significant improvements in submarine cable and satellite systems have given rise to systems with everincreasing capacities making it possible to meet the user's requirements while providing high quality, reliable services on a cost-effective basis.

The Pacific Ocean region is vast with large population centres scattered around the rim. The volume of telecommunications traffic in this region is low compared to that in other regions of the world and the development of telecommunications facilities generally follows that in the other regions. However, in recent years, there has been a rapid development of the socio/economic inter-relationships amongst the

Pacific countries and new facilities are required now to meet the expected rapid traffic growth during the coming years. This need was recognized in the early 1970's when the Pacific rim telecommunications administrations met to review the future requirements for this area. It was decided to initiate planning activities to develop and implement new major trans-Pacific cable systems to replace and/or augment the capacities of the existing systems. The group reaffirmed the continuing need to ensure media and route diversification through the use of satellite and cable transmission systems in order to provide highgrade, reliable telecommunications services. This activity led to the signing in October 1981 of an agreement by fourteen telecommunications administrations for the implementation of a new north-south trans-Pacific cable system linking Australia, New Zealand, Fiji, Hawaii and Canada. This will provide adequate circuit capacity, complementary to the satellite system, to meet the forecasted traffic demand over the next decade. The new cable

system, called ANZCAN, will be placed in service in late 1983 and will form part of the evolving Pacific Basin submarine cable network. Traffic on the ANZCAN system from the Pacific to Europe will be routed via trans-Canada transit facilities and the Atlantic cable facilities.

The planning of the ANZCAN cable system is viewed in the context of the existing and planned telecommunications facilities and the projected traffic requirements in the Pacific region.

2. TRAFFIC GROWTH

During the past decade, the rate of traffic growth in the Pacific

Ocean region has been increasing significantly from year to year. At a traffic database meeting held in Munich, Germany, in 1981, the re-presentatives of the major telecommunications administrations of the Pacific Ocean region, North America and Europe established the projected growth in the Pacific Ocean region to be approximately 15% per year during the period 1985 to 1995.

The traffic data base developed in Munich is divided into three axis between North America and the Pacific destinations served by various trans-Pacific cables and is given in Table 1. The growth is graphically shown in Fig.1.

TABLE 1
PACIFIC REGION TRAFFIC FORECAST
SOURCE: MUNICH MEETING 1981

	<u>Total Traffic</u>		
	<u>Equivalent Two-Way Voice Ccts.</u>		
	<u>1985</u>	<u>1990</u>	<u>1995</u>
1. North America to South Pacific (Assumption - 30% to Cable)	920 (276)	1969 (590)	4233 (1269)
2. North America to N.E. Asia (Assumption - 30% to Cable)	1521 (456)	2850 (855)	5276 (1582)
3. North America to S.E. Asia (Assumption - 30% to Cable)	1591 (477)	3551 (1065)	8304 (2491)
TOTAL TRAFFIC	4032	8370	17813
<u>OTHER CABLE TRAFFIC</u>			
Europe to South Pacific	(503)	(643)	(718)

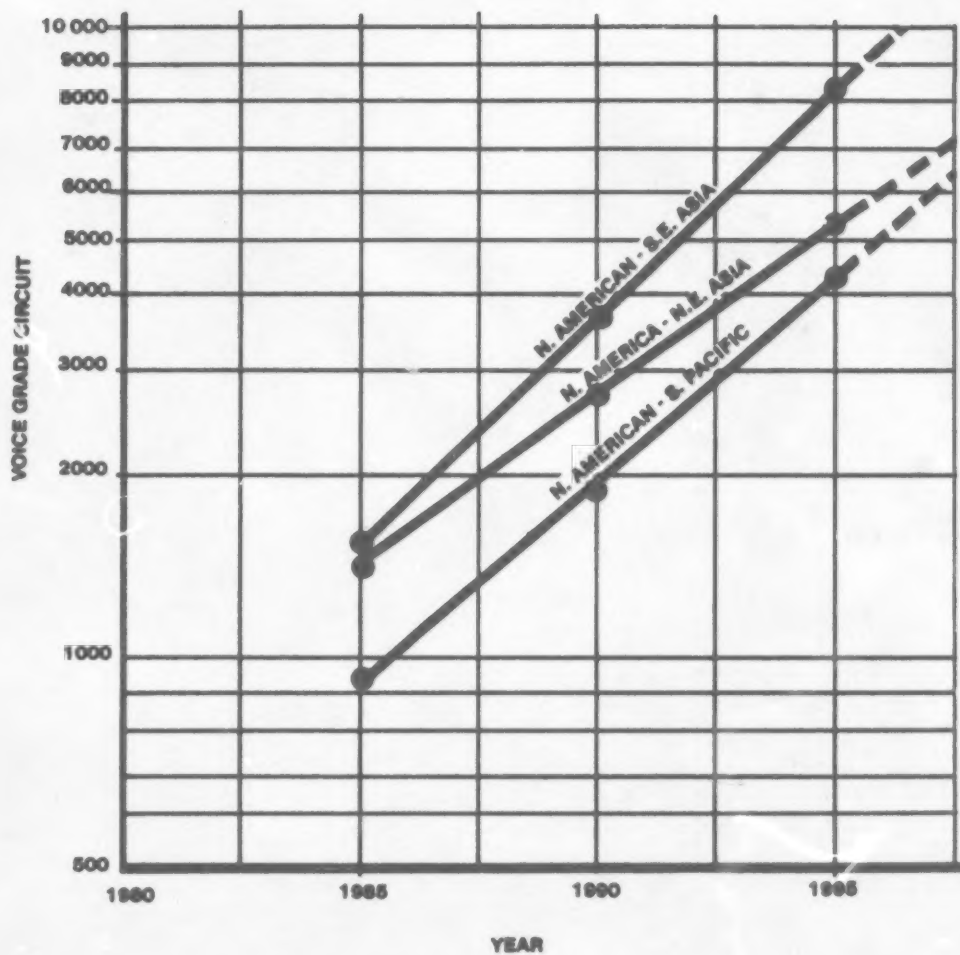


FIGURE - 1: PACIFIC REGION TRAFFIC FORECAST

NOTES:

- A. North America - U.S.A. and Canada
 South Pacific - Australia, New Zealand, Fiji and Papua New Guinea
 N.E. Asia - Japan, South Korea and China
 S.E. Asia - Taiwan, Hong Kong, Philippines, Singapore, Malaysia and Thailand

B. This is not an exhaustive list. A few Asian countries are not included because current traffic data were not included at the Munich Meeting.

3. TRANS-PACIFIC FACILITIES

At present, traffic to the countries in the Pacific area is routed via the INTELSAT POR satellite and via a small number of trans-Pacific and regional cables. The existing and planned trans-Pacific transmissio facilities are illustrated in Fig. 2 and consist of the followings:

- i) The present POR IV satellite which is expected to carry 2867 circuits by the end of 1981, is planned to be replaced by INTELSAT IV-A satellites displaced from the Indian Ocean Region (IOR) around mid-1982. The IV-A satellites are planned, in turn, to be replaced by INTELSAT V satellites during 1984. The present single satellite configuration is under review by INTELSAT and several major countries are planning second antennas to operate with the spare satellite as an operational spare and also for cable restoration.
- ii) The COMPAC cable system links Canada, Hawaii, Fiji, New Zealand and Australia. The system has a design capacity

of 82 circuits (3 kHz circuit bandwidth) and a design life of 20 years ending in 1983. TASI-B circuit multiplication equipments are placed in Vancouver and Sydney to increase the derived capacity with time zone advantage to 333 circuits.

iii) The Hawaii No. 1, 2 and 3 cables link Hawaii with the US mainland providing a combined design capacity of 1038 circuits (3KHz circuit bandwidth). End-of-design lives are 1982, 1989 and 1999 respectively.

iv) The TPC (trans-Pacific) No. 1 & 2 cables link Hawaii with Japan and the Philippines through Guam. These cables have a combined design capacity of 989 circuits (3 kHz circuit bandwidth) and their end-of-design lives are 1989 and the year 2000 respectively.

v) The SEACOM cable links Australia, Papua New Guinea, Guam, Hong Kong, Malaysia and Singapore. The segment between Australia and Guam has a designed capacity of 166 circuits (3 kHz circuit bandwidth) and an end-of-design life in 1987. The other segment between Guam and Singapore has a designed capacity of 82 circuits (3 kHz circuit bandwidth) and an end-of-design life in 1985.

Onward connections from the above cable systems are provided by a number of regional cables that are beginning to criss-cross the South China Sea as shown in Fig. 2. A summary of the trans-Pacific cable systems, including the projected cable traffic requirements between North America and three major groupings of Pacific countries, is given in TABLE 2.

TABLE 2
EXISTING TRANS-PACIFIC CABLES

TRANS-PACIFIC CABLES	SEGMENT	3KHz CAPACITY	END-OF- DESIGN LIFE	REQUIREMENT IN 1995 (ASSUMPTION)
1. <u>NORTH AMERICA-S.E. ASIA (A)</u>				
TPC-1	HAWAII-PHIL	144	1989	
SEACOM	GUAM-PHIL	82	1985	
	TOTAL	326		2491
2. <u>NORTH AMERICA-N.E. ASIA (A)</u>				
TPC-1	GUAM-JAPAN	144	1989	
TPC-2	HAWAII-JAPAN	845	2000	
	TOTAL	989		1581
3. <u>NORTH AMERICA-S. PACIFIC</u>				
COMPAC (B)	HAWAII-AUSTRALIA	82	1983	1987 (C)
4. <u>NORTH AMERICA-HAWAII</u>				
COMPAC (B)	CANADA-HAWAII	82	1983	
HAWAII-1	U.S.A.-HAWAII	51	1982	
HAWAII-2	"	142	1989	
HAWAII-3	"	845	1999	
	TOTAL	1120		6060 (D)

NOTES: A) TPC 1 & 2 are both between Hawaii and Guam which imply that maximum cable capacity from North America to S.E. Asia and N.E. Asia is 989 circuits.

B) COMPAC will be replaced by ANZCAN in 1983/84.

C) Pacific-Europe traffic is included.

D) No U.S. domestic traffic is included. Pacific-Europe traffic is included.

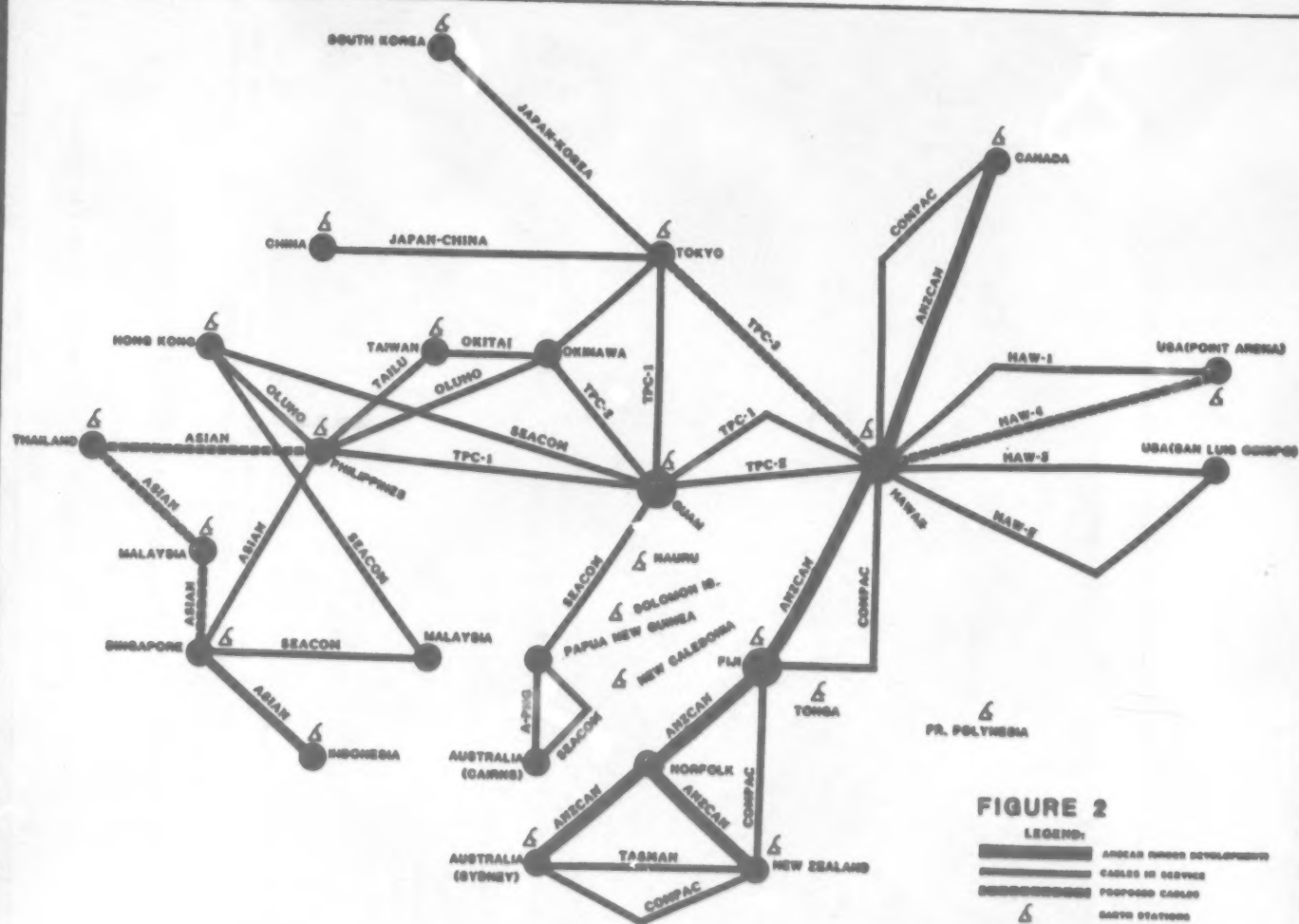


FIGURE 2

LEGEND:

- ARECAN UNDER DEVELOPMENT
- CABLES IN SERVICE
- PROPOSED CABLES
- CABLE STATIONS
- CABLE STATIONS

PACIFIC NETWORK

4. PLANNING OF ANZCAN

The necessity of installing additional cable circuits for trans-Pacific telecommunications traffic was recognized in the early 1970's. At that time, a number of telecommunications administrations in the Pacific Ocean Region undertook to plan the installation of the TRANSPAC-2 Cable linking Hawaii to Okinawa via Guam, a system which has been in service since 1975. It was further recognized that the COMPAC cable system between Australia and Canada via New Zealand, Fiji and Hawaii would be reaching the end of its designed life in the early 1980's and that a new larger-capacity cable system would be required to meet the traffic demands. A meeting of all prospective owners of this new system was held in Hawaii in 1977. It was agreed to develop plans for various trans-Pacific cable options and to identify preferred configuration.

A group of experts from various Pacific Administrations developed several options and presented its recommendations to another meeting of the Pacific Administrations in Tokyo in October 1978. The meeting concluded that the following trans-Pacific cables would need detailed evaluations.

<u>CABLE SYSTEM</u>	<u>CIRCUIT CAPACITY</u>	<u>PROPOSED RFS DATE</u>
Hawaii-Aust.	In excess of 640	1983
Hawaii-Canada	similar	1983
Hawaii-U.S.A.	4000	1982
Hawaii-Japan	1600	1985

Detailed evaluations of the Canada-Hawaii and Hawaii-Australia cables were assigned to Teleglobe and OTC(A).

In view of the importance placed on the trans-Pacific link by Canada, Teleglobe Canada convened another planning meeting in Vancouver in 1979, at which the

participants from a number of European and major Pacific Administrations updated the detailed circuit forecasts which formed the basis for a preliminary implementation plan. This was followed in May 1980 by a meeting of Principals of all Administrations with needs for cable circuits in a north-south trans-Pacific system. The meeting confirmed the strong interest in participation in a new Australia/New Zealand/Canada cable with in-between landing at Hawaii, Fiji and Norfolk Island. The proposed cable was named ANZCAN and a Memorandum of Understanding (MOU) was signed by three European and seven Pacific Operators.

Under this MOU, funds were authorized for the cable route survey, the preparation of the tender specification and tender analysis with the objective of signing contracts in October 1981 for the construction of the cable. In September 1980, major submarine cable system suppliers were invited to tender on one or a combination of segments of the five-segment system, in order. This approach enabled the cable manufacturers to respond to the request for proposals as long as they had at least production capacity for any one of the five segments. In parallel with the implementation work, preparation of the Construction and Maintenance Agreement was authorized.

Following the completion of the above-mentioned tasks, six European and eight Pacific Region Telecommunications Administrations signed the Construction and Maintenance Agreement on October 1, 1981. This agreement committed the signatories to the construction of the 8,200 nautical mile submarine cable system and related cable terminals. The major partners are the Overseas Telecommunications Commission (Australia) with 49.5 percent interest, Teleglobe Canada with 15.5 percent, the New Zealand Post

Office with 15.1 percent, and British Telecom with 10.3 percent. Other investors are Cable and Wireless PLC of Britain; Fiji International Telecommunications Limited; the Ministère des Postes, des Télécommunications et de la Télédiffusion of France; Deutsche Bundespost of Germany; Posts and Telegraphs of Ireland; Italcable of Italy; Kokusai Denshin Denwa of Japan; The Public Utilities Department of Papua New Guinea, The Philippines Long Distance Telephone Company; and the Entreprise des Postes, Téléphones et Télégraphes of Switzerland.

Contracts were signed on October 2, 1981 with two major submarine

cable system manufacturers for the manufacture and installation of this system. Standard Telephones and Cables (STC) of Britain was awarded a 170 million pounds sterling contract for the major route between Canada and Australia while Nippon Electric Co. Ltd. (N.E.C.) of Japan was awarded a U.S. \$33 million contract for the segment between Norfolk Island and New Zealand. Sub-contracts for raw materials and various components of the cable system were awarded to suppliers in Canada, Australia and New Zealand. Table 3 shows the capacity, length and planned in-service date for each of the five segments of the system.

TABLE 3
ANZCAN CABLE SYSTEM

	<u>SEGMENT</u>	<u>CABLE BANDWIDTH</u>	<u>ROUTE LENGTH (NM)</u>	<u>SUPPLIER</u>	<u>READY FOR SERVICE</u>
A.	Norfolk Isl.- Australia	14 MHz	978	S.T.C.	Oct. 1983
B.	Fiji-Norfolk Isl.	14 MHz	994	"	Feb. 1984
C.	Hawaii-Fiji	14 MHz	2989	"	June 1984
D.	Canada-Hawaii	14 MHz	2466	"	July 1983
E.	Norfolk Isl.- New Zealand	5 MHz	732	N.E.C.	Oct. 1983

5. ANZCAN DESIGN PARAMETERS

The ANZCAN is a coaxial analog cable system with a nominal bandwidth of 14 MHz for the four segments between Canada and Australia and a bandwidth of 5 MHz for the segment between New Zealand and Norfolk Island.

The 1380-circuit (4 kHz circuit bandwidth) ANZCAN cable system in the segment between Australia and Canada will have more than twenty times the capacity of the existing COMPAC cable systems it will replace. Also, the 480-circuit (4 kHz circuit bandwidth) segment between New Zealand and Norfolk Island will have more than seven times the capacity of the cable to be replaced. With an expected design life of 25 years, the system will be catering to the ever-expanding telecommunications traffic growth during the next decade of this century and beyond.

The two main system performance objectives defining the transmission requirements are average channel noise power and average channel loading level. The noise power performance of an equivalent voice grade 3 kHz channel averaged over all channels is required to be 1 pWop/km with ± 1.5 dB frequency response over the baseband and better than -70 dB crosstalk between any two channels. The average power loading per channel is not to be less than -12.5 dBmO when operated on a 3 kHz basis. The high channel loading capability will allow the use of speech concentrators (such as TASI/CELTIC) on all channels used to carry voice traffic. Detailed transmission parameters to be met by the suppliers for each segment and end-to-end for segments ABCD are given in Annex 1.

6. ANZCAN INTERCONNECTIONS

The ANZCAN cable system will be interconnected at Hawaii with the

existing and the future east-west trans-Pacific cables. At Fiji and Norfolk Island, circuits will be dropped and inserted for traffic to and from these destinations. The interconnection capabilities at these locations could provide opportunities for some South Pacific Island countries to access this high quality transmission artery for that part of their international traffic which is beyond the visibility of the POR satellite, but which could be accessible terrestrially via ANZCAN. The provision of Pacific-Europe cable circuits via ANZCAN thus avoids a double satellite hop to these destinations.

The long-term circuit termination and interconnection requirements of the cable systems are pictorially shown in Fig. 3.

In Canada, the cable terminal on the west coast will be interconnected via leased microwave facilities to the trans-Atlantic cables. This will provide hard wired terrestrial interconnection for routing the Pacific-Europe traffic.

7. CONCLUSIONS

Planning the installation of a major submarine cable system is a highly complex operation requiring close co-operation amongst the prospective owners. This paper described the development of the ANZCAN project along with its design parameters and long-term interconnection plan, which will be of great importance in expanding the range and quantity of international telecommunication services in the Pacific basin. With an expected design life of 25 years and more than twenty times the capacity of the cable it will replace, the system will be carrying telephone and other telecommunications traffic well into the first decade of the 21st century.

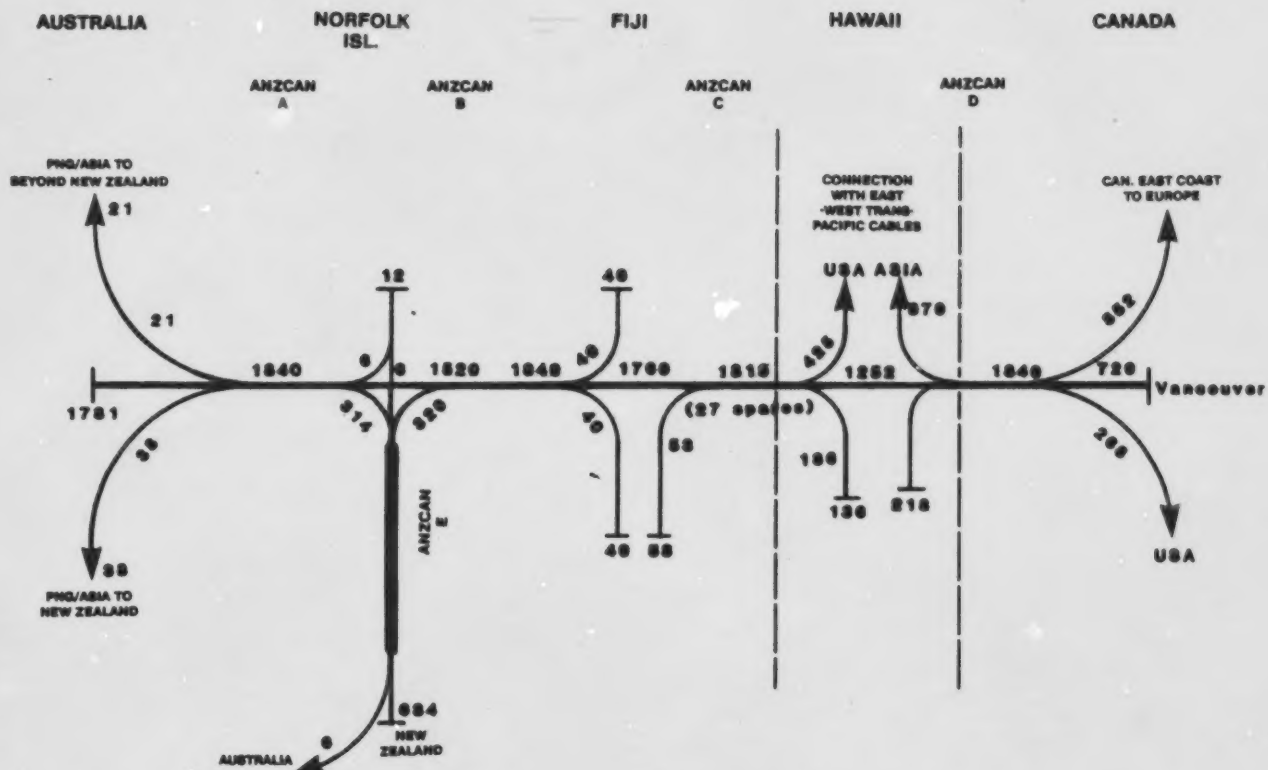


FIGURE - 3: ANZCAN LONG TERM TERMINATION AND INTERCONNECTION REQUIREMENTS

ANNEX - 1

ANZCAN CABLE SYSTEM TRANSMISSION PARAMETERS

<u>PARAMETER</u>	<u>TRANSMISSION REQUIREMENT EACH SEGMENT</u>	<u>PERFORMANCE END-TO-END REQUIREMENTS FOR SEGMENTS ABCD</u>
1. <u>SEGMENT/ANZCAN Cable System Design Life</u>	25 years	25 years
2. <u>Maximum Spread of Insertion Gain/Frequency Response</u> (after equalization)		
(a) Over the baseband (relative to mid frequency gain)	+ 1.5 dB	-
(b) In any hypergroup band	2 dB	-
(c) In any supergroup band	1 dB	1 dB
(d) In any group band	0.5 dB	0.5 dB
(e) In any equivalent voice grade channel band for at least 96% of channels	0.2 dB	0.2 dB
(f) In any equivalent voice grade channel band for not more than 4% of channels	0.4 dB	0.4 dB
3. <u>Average Equivalent Voice Grade Channel Loading Capability to be not less than</u>	-12.5 dBmO*	-12.5 dBmO*
4. <u>Maximum Noise per Equivalent Voice Grade Channel</u>		
(a) Averaged over all channels	1pWOp/km*	1pWOp/km*
(b) In worst channel	2pWOp/km*	2pWOp/km*
5. <u>Maximum Crosstalk</u> (between any two channels)		
(a) At the hypergroup distribution frame	-80 dB	-
(b) At the points S, S' (as defined in CCITT Rec. G.371)	-76 dB	-70 dB

APPENDIX - 1 (CONT'D)
ANZCAN CABLE SYSTEM PARAMETERS

<u>PARAMETER</u>	<u>TRANSMISSION REQUIREMENT EACH SEGMENT</u>	<u>PERFORMANCE END-TO-END REQUIREMENTS FOR SEGMENTS ABCD</u>
6. <u>Maximum In-Band Carrier Leaks, Spurious Frequencies and Unwanted Products of Modulation</u>	-70 dBmO	-64 dBmO
7. <u>Maximum Impulsive Noise</u>		
(a) In any channel (in excess of -28 dBmO threshold)		
(b) In any group (in excess of -17dBmO threshold)	6 counts in 15 minutes	6 counts in 15 minutes
(c) In any supergroup (in excess of -10dBmO threshold)		
8. <u>Maximum Peak-to-Peak Phase Jitter</u>		
(a) Worst channel	4 degrees	8 degrees
(b) Averaged over a number of channels (at least one per supergroup)	2 degrees	4 degrees

* when operated on a 3 kHz basis.

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THE EVOLUTION OF INTEGRATED PACKET AND CIRCUIT SWITCHING TECHNOLOGY

by

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1. Abstract

The switching technique is the heart of a distributed communications network. The choice of switching technique has major impact on the efficiency of communications lines and processors, on the performance as seen by the user, and on the flexibility of the network in handling different types of traffic requirements. In this paper we analyze the evolution of the switching technology in the past decade and follow the progress that has occurred in two fields traditionally viewed as opposed to each other -- packet switching and circuit switching. We note surprising similarities of approaches in the most recent implementations of these two schemes, which lead us to predict that a combined packet and circuit switching scheme will be the emerging technology of the '80s.

2. INTRODUCTION

The switching technique is the heart of a distributed communications network. The choice of switching technique has major impact on the efficiency of communications lines and processors, on the performance as seen by the user, and on the flexibility of the network in handling different types of traffic requirements. In this paper we analyze the evolution of the switching technology in the past decade and follow the progress that has occurred in two fields traditionally viewed as opposed to each other -- packet switching and circuit switching. We note surprising similarities of approaches in the most recent implementations of these two schemes, which lead us to predict that a combined packet and circuit switching scheme will be the emerging technology of the '80s.

Figure 1 shows the evolution of data switching techniques in the past decade. Back in the sixties, data switching was done using analog circuit-switched networks, like the telephone network, for example. In this type of network (see Figure 2), several voice-grade channels are frequency-division multiplexed on each trunk. Each channel can carry data at a rate of up to 4.8Kbps. If two users, say, A and B, want to communicate with each other, a circuit-switched connection must be set up; that is, a series of channels must be assigned along the path from A to B. These channels are released only when the communication session between A and B is completed.

Advantages of the circuit-switched network arrangement are protocol transparency (the network does not have to recognize user code nor

does it have to look for special control characters in the user stream), and geographical availability.

Unfortunately, circuit switching gives poor bandwidth utilization for most computer data transfers since terminal traffic is bursty, intermittent in nature, and bandwidth is wasted during idle times. Other drawbacks are the delay to set up the end-to-end connection (typically several seconds are required to set up such a connection), the data rate limitation of 4.8Kbps, and the lack of error control along the path.

To overcome the problems of analog circuit switching, an intense research effort was promoted in the late 60s by ARPA, the advanced research branch of the Department of Defense, to explore more efficient techniques for computer communications. The result was the ARPA Experimental Packet Switched Network known as ARPANET [ROBE 70], [HEAR 70].

2. THE EVOLUTION OF PACKET TECHNOLOGY

In ARPANET, user data is packet-switched; that is, a user message is segmented into packets, and each packet is carried to destination independently, in a store-and-forward fashion. Packets are buffered at each intermediate node, and are forwarded to the next node on the route based on their destination, which is carried in the header, and according to the routing policy, which is implemented at each node (see Figure 3).

An error detection and retransmission scheme permits recovery from line errors on each hop along the path. A dynamic routing policy allows packets within the same message to follow different paths in order to avoid temporary congestion, or to bypass links or nodes which have failed. At the exit switch, packets are reassembled into a message, which is then delivered to the destination user.

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Packet switching offers several advantages over circuit switching. Most importantly:

- o Connection setup delay is lower (on the order of fractions of a second);
- o Lines are better utilized since line capacity is shared among several users, instead of being assigned to an individual pair of users;
- o User data is protected against line errors and failures; and
- o The network can provide conversion of speed, code, and protocol between the end users.

Unfortunately, these advantages do not come free. The price that we pay is in terms of:

- o Higher delays for the transport of packets across the network (after the connection has been set up). This is because each packet must be assembled at each intermediate node.
- o Higher storage requirement because packets and messages must be buffered in the network.
- o Loss of transparency, since now the network must understand the control information contained in each message. For example, the network must interpret the address information set by the user.
- o Tendency to become congested since the network may absorb more packets than it can actually deliver to destination. Complex and often costly control schemes must be implemented in order to avoid congestion and its consequences, which are: performance degradation, buffer overflow, and deadlocks.

Part of the storage and congestion problems arising in the ARPA Network were traced to the handling of multipacket messages within the network. Messages must be packetized, sequenced, and reassembled: all of these operations require considerable network resources.

In an effort to remove this source of trouble, the packet-switched protocol was streamlined and transformed into the so-called datagram protocol. In the datagram network, user messages (called datagrams) are transported from source to destination along the minimum delay path. There is no attempt to split messages into smaller blocks nor to keep messages in sequence. If congestion builds up in the network, messages are simply dropped. It is, therefore, the user's responsibility to create messages of suitable size, to resequence messages at the destination, and to recover from eventual losses. An example of datagram network is represented by Cyclades, an experimental computer network built in France in the early '70s [POUZ 73].

Up to the mid-70s, the computer network evolution was mostly represented by experimental networks

(example: ARPANET and Cyclades) or private networks (example: SITA [KRON 75] and Tymnet [RIND 76]). By the mid-70s the potential of packet switching for public data networks became clear to public and specialized communications carriers. The packet-switched technology was well demonstrated and commercially available, and the market was ready. The major obstacle was the nontransparency of packet networks to user protocols. In other words, a custom made, and therefore costly, interface had to be developed to connect an arbitrary user device to an arbitrary packet network. In order to overcome this problem and avoid the proliferation of software interfaces, a standard network access protocol had to be defined between user and network.

After a laborious process which lasted two years and (to some extent) is still going on now, the Committee for International Standards in Telephony (known as CCITT) published in 1976 a proposal for the universal standard access protocol to a packet network.

This protocol, known as the X.25 access protocol, represents a major departure from the datagram protocol implemented in ARPANET and Cyclades. It is, in fact, a virtual circuit protocol in which a virtual circuit is associated to each user session before data transmission can begin. In most X.25 networks the establishment of the virtual circuit implies the selection of a network path to be assigned to the session. A call set-up procedure is used to establish the path between two users, in a way very similar to what is being done in conventional circuit-switched networks (see Figure 4). It is, however, a virtual, rather than physical, circuit-switched protocol because of the fact that circuits do not own bandwidth, rather they share it dynamically on a packet-by-packet basis [RYBC 77].

The virtual circuit protocol offers several advantages over the datagram protocol. In particular, the packet header is shorter since after virtual circuit establishment, each user session is uniquely identified by a 12-bit ID number. On the other hand, in some datagram implementations, source and destination information uses as much as 240 bits (see Figure 5). Other advantages with respect to the datagram scheme are the preservation of packet sequencing across the network, and the capability to selectively control the flow on individual user sessions. For example, if congestion builds up in some region of the network, only the virtual circuits that traverse that region are flow controlled; the remaining circuits are left undisturbed. This selective operation is in contrast with the datagram approach, where local congestion tends to spread to the entire network before it can be stopped.

Today, the majority of public (as well as private) networks have adopted the X.25 standard and are operated in the virtual circuit mode. We may mention, among the many networks in existence, Teletnet [OPDE 78], Transpac [SIMO 79], and Tymnet [RIND 76].

EVOLUTION OF DATA SWITCHING TECHNIQUES

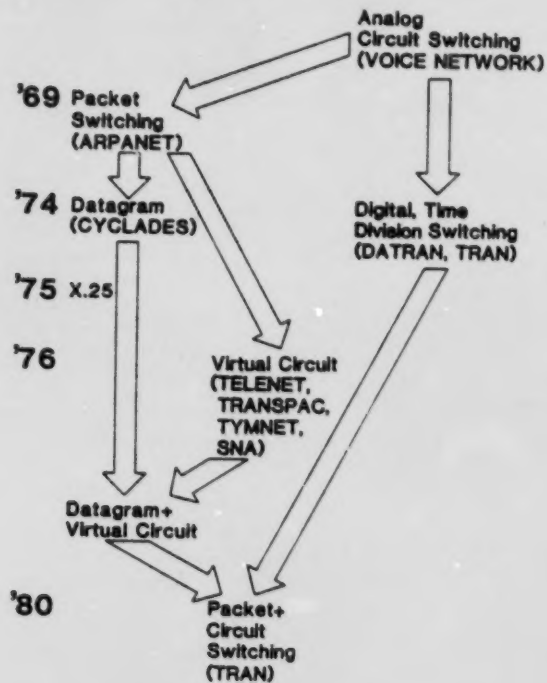


Figure 1

DISTRIBUTED PACKET - SWITCHED (P/S) NETWORKS

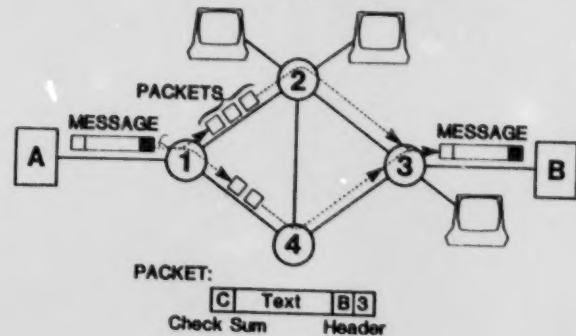


Figure 3

X.25 VIRTUAL CIRCUIT PROTOCOL

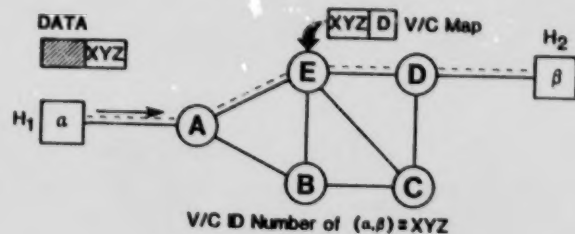


Figure 4

ANALOG CIRCUIT SWITCHED (C/S) NETWORK EXAMPLE: TELEPHONE NETWORK

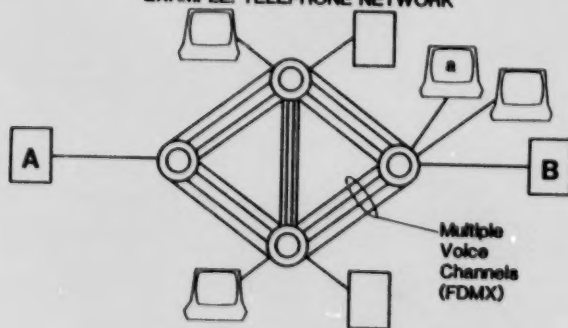


Figure 2

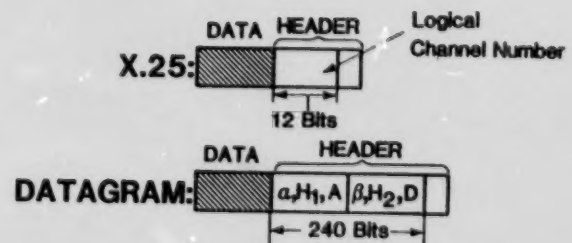


Figure 5

The X.25 virtual circuit protocol offers several advantages over the datagram protocol. One shortcoming of X.25, however, is the delay involved in setting up a virtual circuit. In some cases this delay could be on the order of several seconds. Inquiry/response applications could be adversely affected by this delay, and by the overhead involved in creating and releasing the virtual circuit for each transaction. To overcome this intrinsic limitation of virtual circuit in dealing with transaction-oriented traffic, CCITT has recently revised and expanded the X.25 specifications to incorporate also the Datagram option [FOLT 80].

By studying the evolution of packet switching from the ARPA experiment to the X.25 specification, we notice that while the early packet schemes attempted to erase all traces of circuit switching from the transport protocol, the more recent packet implementations are returning to more conservative positions by reintroducing the notion of calls and fixed paths which were really created by circuit switching.

In parallel with the development of the various packet switching schemes, the circuit switching technology also underwent an important evolution. The first stage of this evolution was time-division switching.

3. THE EVOLUTION OF CIRCUIT-SWITCHED TECHNOLOGY

The time-division switching technique, pioneered by Tran [GERL 78], emerged in the early 70s as the solution to many of the problems affecting conventional analog switching. In time-division switching (see Figure 6), data on each trunk is carried in frames of fixed duration (in our example, 200msec). Each frame contains several character slots. The number of slots is proportional to trunk speed. In the example in Figure 6, on a 300bps trunk, the frame carries six characters, and on a 150bps trunk, it carries three characters.

When a circuit-switched connection is established, a proper number of character slots (corresponding to the bandwidth of the connection), is reserved along the path. For example, connection A-A' has a rate of 100 baud (i.e., 10 characters per second) and, therefore, uses two slots in each intermediate frame. Connection B-B' has a rate of 50 baud (i.e., 5 characters per second), and uses only one slot per frame.

At each intermediate node, channel tables map incoming slots to outgoing slots. A new entry in the channel table is made when a connection is established. The entry is deleted when the connection is cleared.

In order to avoid spilling of characters, the frames must be synchronized throughout the network. This is guaranteed by a master clocking mechanism. In order to minimize character buffer-

ing delays, user data slots are interleaved on each frame.

Time division switching offers substantial advantages over conventional analog switching. Most importantly, circuit setup delays are reduced by an order of magnitude, due to the use of stored program processors and common channel signaling.

Also, broader ranges of speeds can be efficiently connected through the network. The 4800bps limitation is removed and circuits of speed up to 56Kbps can be connected. On the low end, circuits of speed as low as 50bps can be established without wastage of trunk bandwidth as it typically occurred in analog networks where a voice-grade channel had to be allocated in all cases. Furthermore, time division multiplexing can be accomplished more efficiently than frequency division multiplexing since no guard band is wasted due to filtering.

Finally, line quality is substantially improved since the digital signal is more robust to noise than the analog signal.

Using time-division switching, we can establish circuits between arbitrary node pairs. In particular, we can create circuits between adjacent nodes. We can do this systematically, and set aside a portion of the trunk bandwidth (i.e., a set of slots in the frame) for communications between adjacent nodes. We can go one step further and agree that on this portion of bandwidth, data between adjacent nodes is transmitted using a packet format.

This way, from the original network, we have derived a packet-switched subnetwork using time-division switching. This is really the essence of the hybrid packet and circuit-switching architecture based on a time-division structure.

4. HYBRID PACKET- AND CIRCUIT-SWITCHING

In the hybrid architecture, the portion of trunk bandwidth not allocated to circuit connections is available for packet traffic. The user can select the circuit or packet service, depending on his characteristics and needs. In the hybrid example shown in Figure 7, A-A' and B-B' choose the circuit-switched service, while C-C' selects the packet service. The partition between packet and circuit bandwidth is determined by the relative packet and circuit traffic volumes.

The hybrid packet and circuit solution represents the last step (for the time being) in our evolution chart shown in Figure 1. It is the merging point of two technologies which were viewed as diametrically opposite only ten years ago, and now, after a long evolutionary process, are found to have several points in common.

Although the common foundation of all hybrid switching schemes is time division switching,

DIGITAL CIRCUIT SWITCHED NETWORK: BASIC TIME DIVISION SWITCHING STRUCTURE

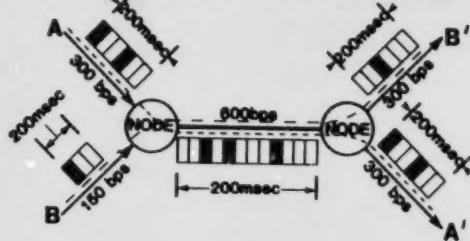


Figure 6

PACUIT LINK

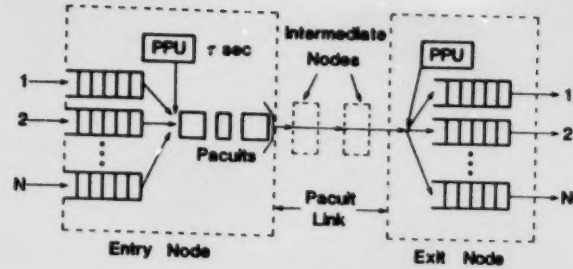


Figure 9

HYBRID NETWORK: PACKET SWITCHING AND CIRCUIT SWITCHING

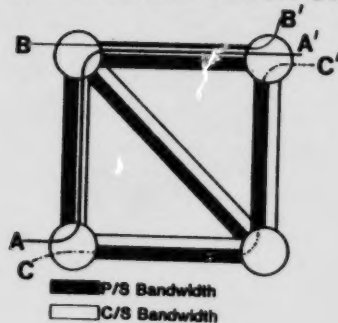


Figure 7

SLOTTED ENVELOPE FORMAT

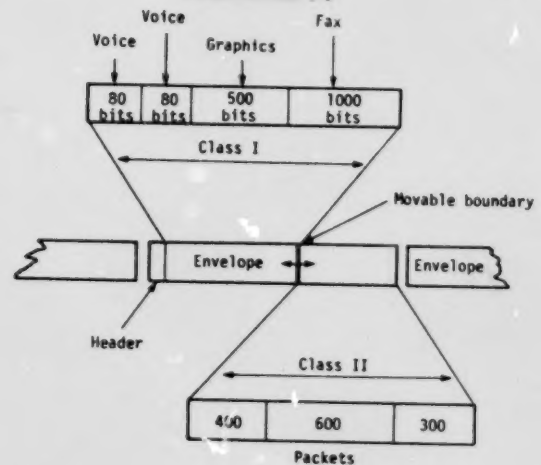


Figure 10

TRAN NETWORK BANDWIDTH ORGANIZATION

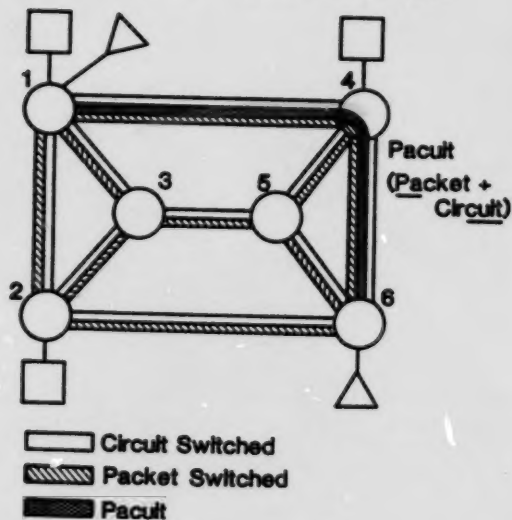


Figure 8

many different versions of hybrid switching have been proposed and implemented. In the commercial network area, one of the pioneers of hybrid switching has been Tran Telecommunications Corporation. The Tran network provides X.25 packet services and circuit switched services within the same switch [GERL 78]. Due to the modularity of the switch architecture, packet and circuit processing power of the switch can be separately adjusted so as to meet specific user requirements in the most cost effective way. The Tran network offers also the possibility of establishing "super circuits" between remote nodes (for example, between node 1 and node 6 in Figure 8), on which several asynchronous users are statistically multiplexed. User data is assembled into packets at the entry node. The packets are then carried transparently to their destination via the super circuit. This combination of packet and circuit elements led to the name Pacuit (or, Packet plus Circuit) for this transport scheme.

The operation of a Pacuit link is now reviewed in some detail (see Figure 9). A Pacuit link is a full duplex pipe maintained between two nodes in the network. This pipe is circuit switched through intermediate nodes. Incoming user characters are buffered in separate buffers. Periodically, every τ seconds, the buffer contents are assembled into packets by the PPU (Pacuit Processor Unit). These packets are transported to destination on a first-come/first-served mode on the Pacuit link. Some queueing delay may occasionally be incurred if the instantaneous character arrival rate exceeds Pacuit bandwidth. If the queueing problem persists, more bandwidth is dynamically allocated to the Pacuit link to accommodate the increased load.

Error and flow control on the packet stream is obtained with an SDLC-like protocol maintained between entry and exit node. At the exit node, the packet is disassembled and the individual contributions are distributed among the final destinations.

The innovative aspects of this protocol, with respect to the standard packet protocol, are the composite packet format which combines several users in the same packet envelope; and the fact that user messages are transmitted "on the fly," without awaiting complete reassembly of the message at the entry node and at intermediate nodes.

The composite packet format permits reduction of line overhead, since the same packet envelope is shared among several users. The on-the-fly operation reduces end-to-end delay since it permits overlap of local access time and network delivery time [GERL 78].

In the Tran implementation, circuit traffic is handled transparently at each switch. Namely, for the entire duration of the circuit-switched session, input character slots are mapped into output slots regardless of whether data or idle characters are transmitted on the circuit. If

the switch had the capability to detect "unused" slots (i.e., slots carrying idle characters) in each individual circuit that traverses it, it could then dynamically reassign these slots to packet traffic, thus improving bandwidth efficiency (at the expense, of course, of additional switch complexity). A hybrid technique exploiting this principle has been proposed for the experimental network SENET (Slotted Envelope Network) [COVI 75].

In SENET, data on each trunk is carried in frames called "envelopes." These envelopes are transmitted synchronously on all trunks, as frames are in a time division switched network. As a difference, however, the envelope structure is subdivided into segments (rather than character slots), each segment carrying all the data for a specific channel (see Figure 10) (i.e., the data characters for each channel are grouped into one single segment rather than being interleaved with other channels throughout the frame).

A movable boundary separates Class I data (i.e., circuit switched channels) from Class II data (i.e., packets). Each circuit switched channel is assigned a fixed position in the envelope at connect time. Character slots, however, are not permanently assigned to each channel; rather, the presence or absence of data is detected and idle characters are suppressed. Namely, a circuit-switched channel which is temporarily idle will be represented in the envelope only by an "absence" flag. This permits the boundary between Class I and Class II traffic to be dynamically adjusted, so that any temporarily unused circuit-switched bandwidth is reassigned to packet traffic. In order to implement the movable boundary feature, the envelope must, of course, be completely assembled in the switch before transmission. This is in contrast with the "on-the-fly" disassembly and reassembly of frames made possible by the Tran implementation.

The main advantage of the SENET technique is the improvement in bandwidth sharing. This improvement is particularly significant when circuit-switched traffic is bursty. It is not a coincidence that the SENET was specifically designed to support digitized speech characterized by the alternation of active (i.e., talking) and silence (i.e., listening) periods. Furthermore, the talking periods consist of a sequence of talkspurts separated by short pauses. In the original SENET design the envelope size was chosen to be sufficiently small (i.e., 10msec) so as to allow speech bandwidth recovery not only during the silence periods, but also during the short pauses.

The increased bandwidth efficiency of the SENET scheme does not come for free. The penalties are: higher delay (at each intermediate node circuit traffic is delayed, on average, by a half envelope interval); higher line overhead (each envelope must carry the "idle" map to permit correct demultiplexing at the receiving node); and higher switch complexity (busy/idle detection and envelope assembly/disassembly).

Other versions of hybrid schemes which mostly resemble the SENET scheme are reported in [FISH 76], [MCAU 78], and [ROSS 78].

Having outlined the key features of a hybrid network architecture and having discussed various possible implementations, we now want to review the motivation for selecting a hybrid system.

5. WHY HYBRID SWITCHING?

First, all the services and features of packet switching are available in the hybrid system, namely, low setup delay for time-critical applications; line efficiency; error control; alternate routing; speed, code, and protocol conversion. In addition, the circuit-switching service is available and can be used for bulk data transfers (e.g., tape-to-tape); or, for applications requiring protocol transparency; or, for real time, constant bandwidth traffic, such as digitized speech or facsimile; or, finally, for applications requiring bandwidth guarantee, where the user cannot tolerate bandwidth fluctuations, as in the packet-switched service.

In addition to the standard packet and circuit services, specialized transport schemes can be developed. For example, Pacuit can be efficiently used for the transparent and bandwidth-efficient transmission of asynchronous traffic. Or, a slotted envelope mechanism can be superimposed to carry digitized speech in a predominantly voice-oriented environment. Furthermore, the underlying time-division structure can be exploited to partition the bandwidth and create a number of subnetworks operating independently. This may be useful in the case of multiple applications coexisting in the network, where each application must be physically isolated from other applications for security and/or interference-prevention reasons.

In summary, the hybrid architecture provides added flexibility in the transport scheme selection (i.e., datagram, virtual circuit, switched circuit, permanent circuit, Pacuit, shared SENET-type circuit, et.). It also permits the user to reconfigure the original topology, by deriving (via time-division switching) an arbitrary number of independent packet subnetworks, with arbitrary connectivity.

6. THE FUTURE OF HYBRID SWITCHING

So far, we have discussed the historical evolution that has brought hybrid data switching to us and have reviewed the advantages offered by a hybrid architecture. The question now is, what is going to happen in the next ten years? How is hybrid switching going to fare with respect to the competition?

To answer these questions, we first must identify the causes that stimulate network evolution. These are:

- o The advances of computer technology

- o The growth and evolution of user requirements
- o The proliferation of new network applications
- o The emergence of new network environments

Let us review these elements one-by-one in more detail.

Technological advances will reduce processor costs by means of modularization and VLSI integration of protocols and control functions. Memory costs will drop. Also, advances in bus and interconnection network technology will allow us to exploit the power of the microprocessor modules by interconnecting them in efficient multimicroprocessor architectures.

As for user demands, we will certainly see an explosive increase in traffic volumes, both in public and private networks. The need for transparency will still be very strong, since the conversion to the X.25 standards may take a fairly long time to be completed by computer and terminal manufacturers. Network bandwidth partitioning will become a very desirable feature, especially in networks shared by different, possibly competing, organizations. Users will have very diversified sets of resource and performance requirements, from the fraction of a second response time for transaction traffic to the megabit-per-second bandwidth for large file transfers.

A large number of new applications will emerge. Among these, we may mention voice, facsimile, and video. Traditionally, these applications have been carried by analog networks. In view of the recent advances in office automation, however, it is inevitable that these services will be integrated with the more conventional data traffic into a common network.

New network environments also will emerge on the side of the more traditional terrestrial, geographically distributed network architectures. We will see a proliferation of local network architectures arranged around a high speed ring or a broadcast cable. On the other side of the spectrum, we will see an increase in multiple access, broadcast satellite networks. The existence of these different network varieties and the need for users to intercommunicate between any two points in the world will pose challenging problems for the interconnection of such networks.

The question now is, what will be the impact of these trends on the hybrid switching technology?

It appears that the hybrid technology is the technology which is best prepared to satisfy the growing requirements of the next decade. In particular:

1. The advances in multimicroprocessor technology will permit a more cost-effective integration of packet and circuit protocols

in the same nodal architecture. In fact, the cost of hybrid switches will become comparable to the cost of packet switches.

2. Even with the most advanced multimicro-processor technology, a packet switch can handle only up to the order of a megabit worth of traffic because of the overhead involved in handling each packet individually. Future traffic volumes will be far beyond the megabit level. Only circuit switching can efficiently handle such traffic volumes. Thus, hybrid switching presents itself as the only viable solution to very high data rates.
3. The presence of data, voice, facsimile, and possibly video requirements in the same network requires a careful allocation of bandwidth resources to these different services, which can be achieved only with a hybrid architecture.
4. Finally, the interconnection of local networks and satellite networks (both operating at megabit per second speeds) may require the establishment of megabit connections between the local network gateway and the satellite gateway. If a terrestrial network is used for the interconnection, a hybrid architecture is essential to support high bandwidth end-to-end connections.

All of these elements point to the conclusion that hybrid switching is a very attractive solution for the network problems of the next decade.

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Integrating Voice Store & Forward System Into The Sprint Network

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Abstract

Voice Store and Forward service is an extension of the data messaging concept. This service allows a user to store a message in his or her own voice, to be either forwarded to another party on a time delayed basis over the telephone network or made available for retrieval at a future time convenient for the called party. A Voice Store and Forward System, offering asynchronous service, will be integrated into SPCC's common carrier telecommunication voice network. In order to provide the VS&F service, several fundamental networking problems had to be resolved. Various possible network configurations for offering a VS&F service are discussed in this paper. We believe that the configuration chosen by SPCC provides an adequate set of options for our customers to satisfy their needs, plus we believe that the resulting network will make efficient use of expensive long distance transmission facilities.

1. SPCC AND THE SPRINT NETWORK

Southern Pacific Communications Company (SPCC), formed in 1970, is a wholly-owned subsidiary of the Southern Pacific Company. The company provides SPRINT, a switched voice service, and dedicated private line services to business and residential customers in direct competition with the operating common carriers (OCC). As quoted from the FCC decision, the permission for SPCC to enter this market is "to promote the introduction of newer and more diverse services, and at a faster rate than the established OCC's would provide."

The current SPCC switched network is shown in Figure 1. The switching network is hierarchical with three levels (1). The routing plan of the SPRINT network is shown in figure 2. The network has fifteen (15) switching centers, housing a total of 47 stored program controlled electronic switches, and is growing rapidly.

The transmission facilities consist predominantly of analog microwave radios with a typical cross-section capacity of 2400 voice channels. This radio network is supplemented by about 3000 leased satellite circuits and some leased terrestrial circuits. The network has 46 million route circuit miles of transmission facilities and serves over 150 metropolitan areas encompassing thousands of communities, including those served via foreign exchange (FX) groups.

The projected growth of the SPRINT network is such, that by 1985, over 85% of the

population in the continental United States will have access to the SPRINT service. The growth plan covers not only an increase in the load carrying capacity, but also the introduction of a number of new services and features. Voice Store and Forward is one of the new services to be offered to the subscribers.

2. VOICE STORE AND FORWARD OVERVIEW

The technology for Voice Store and Forward (VS&F) service has come of age. This is made possible by a continuous and sharp reduction in the price of information storage media, and the advancement in voice encoding and compaction technology. The introduction of VS&F service allows two parties, separated in space and time, to communicate effectively in an asynchronous mode.

Voice Store and Forward services are named literally. The name means that a voice message can be stored as digital information, just like a telegram, and then automatically transmitted to another location, either in near real time, or at a user specified future time. It can be stored for an indefinite period of time, and then retrieved by the called party at the time of his choosing, thus giving the ability to communicate across time with a recorded message. The recipient can append a reply to the message he receives and forward it to other parties. Various options and capabilities are described later in this paper.

A unique advantage of Voice Store and

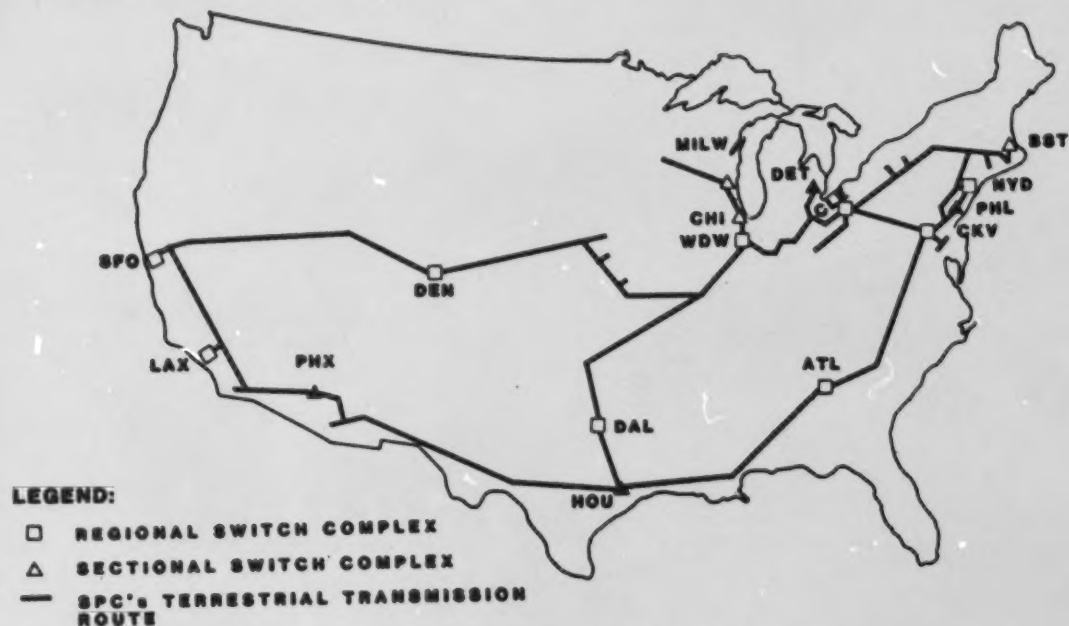
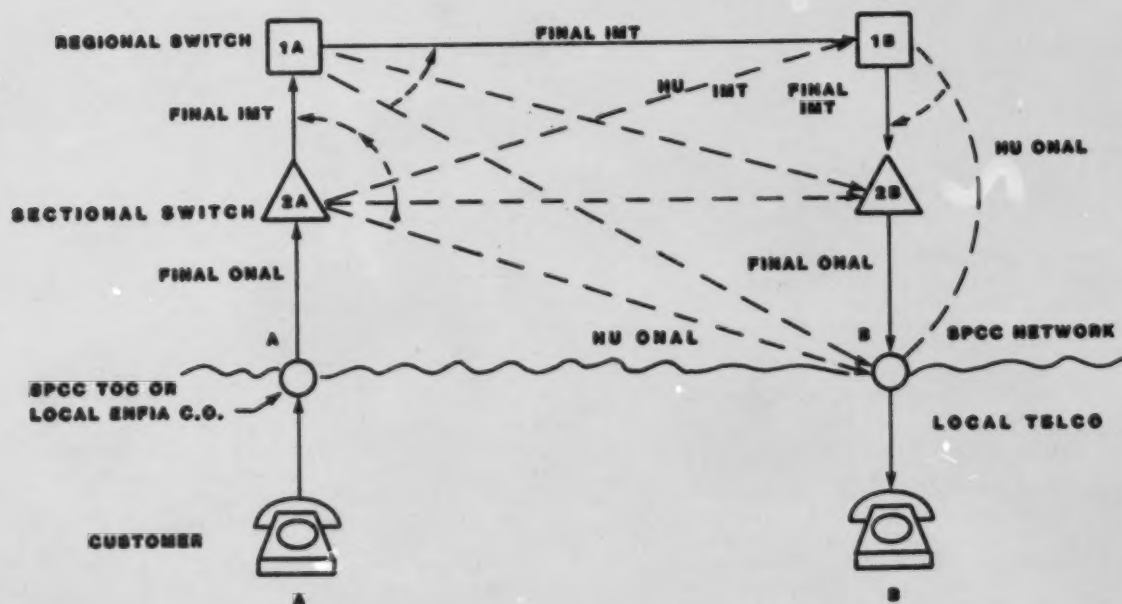


FIGURE 1
SPCC SWITCHED NETWORK 1981



ARROWS INDICATE POSSIBLE ROUTES, A CALL ORIGINATING AT A COULD TAKE IN COMPLETING THE CALL TO CALLED PARTY B.

FIGURE 2
SPRINT NETWORK ACCESSING PLAN

Forward technology over normal data messaging is that it does not require any new or unique hardware at a user's location. All that the user requires is a telephone, available almost anywhere in the world. Unlike the data communication industry at this time, all voice terminals (telephones) are compatible.

Typically, a VS&F system consists of 4 basic components (2,3,4): a front-end phone line interface to connect the VS&F unit to the public/private voice network; a CODEC unit to accept analog voice signals and convert to digital format (compression may or may not be introduced); a processor to provide all the real-time central control functions; and, disks to provide storage for the digitized voice messages (figure 3).

There are several basic system functions: the identification and validation of a user; the organization and storage of voice messages; the retrieval and delivery of stored messages; and, the keeping of necessary statistics for accounting purposes.

The following four methods of inter-connecting a VS&F system to public/private voice networks are being implemented currently by various companies:

1. With a Class 5 Central Office (C.O.) by integration.
2. With a Class 5 C.O. by line tapping.
3. With a PBX by integration.
4. With customers as a standalone, dial up service center.

These different alternatives are briefly described in the following sections.

2.1 CLASS 5 C.O. INTERFACE BY INTEGRATION

In this configuration, the VS&F system is integrated as a part of an electronic switch (Class 5 C.O.). A subscriber is identified by the subscriber line (figure 4a), as this subscriber line is monitored by the switch. If a ringing tone is detected on the line, and there is no off-hook signal from the line after a predetermined number of rings, the call is intercepted and connected to the VS&F system. The caller is then prompted by recorded messages to leave a message to the called party.

When the subscriber line goes off hook, the subscriber is prompted by a tone indicating pending messages. The subscriber can dial up the VS&F system for retrieval of his messages.

2.2 SUBSCRIBER LINE TAPPING INTERFACE

In this configuration, the VS&F system is typically located at a site remote from the C.O.'s. Intelligent concentrators are placed in the local C.O.'s that serve the VS&F subscribers. The subscriber lines coming into the C.O.'s are tapped. A ringing tone on a subscriber line can be detected by the concentrator, and the call can be intercepted if on-hook condition is still prevalent after a predetermined or specified number of rings.

A Direct Inward Dialing (DID) trunk group connects the concentrator to the remote VS&F system. The concentrator connects the calling party to the VS&F system and passes along the information to identify the subscriber line. Once the connection is made through a DID line, the caller is allowed to interact with the VS&F system (figure 4b).

The same may be accomplished by using the call forwarding feature available in C.O.'s equipped with electronic switching systems. In this case, a concentrator is not required.

2.3 PBX INTERFACE

In this configuration, the VS&F system is integrated as part of an electronic PBX. The operation is very similar to the Class 5 C.O. interface as described in paragraph 2.1. The lines are being monitored by the PBX. This configuration is suitable for medium to large business users who own and operate PBX's (figure 4c).

2.4 STANDALONE DIALUP INTERFACE

In this configuration, the VS&F system offers direct dial up service to the user community. The VS&F system interfaces with C.O.'s by DID trunk groups. A group of users access the VS&F service center by dialing one common phone number. Subscribers must be identified by multi-digit I.D. numbers that are entered by DTMF tones. Additional security may be introduced by passwords or other identifying numbers (e.g., mailbox numbers).

3. SPCC'S VOICE STORE & FORWARD SERVICE

To offer Voice Store and Forward services to its subscribers, SPCC has chosen the standalone configuration of its electronic Voice Store and Forward Systems (reference Section 2.4). Each subscriber is identified by a multiple digit I.D. number, and may subscribe to one or more mailboxes. Each mailbox is identified by a separate multiple digit mailbox number. Typical services to be offered include:

- a) Message Storage
- b) Message Retrieval
- c) Message Broadcasting
- d) Message Forwarding

These services are described in the following sections.

3.1 MESSAGE STORAGE

To send a message, the subscriber dials the phone number of the SPCC VS&F access node closest to him; there will be more than 100 nodes in service for the initial offering. At the response from the system, the user identifies himself using DTMF signalling. This is accomplished on standard push button phones or through separate DTMF pads which can be used with rotary dial phones. The subscriber speaks into the phone to record his message. While recording, the subscriber has the ability to pause, fast-forward, rewind, playback, cancel, or stop. With each voice recording, the subscriber supplies the destination addresses for message delivery by entering one or more logical mailbox numbers of the designated called parties. The logical mailbox numbers may be substituted by a 7 or 10 digit phone number for the message to be delivered to a phone. The called party's phone, if located in a foreign country, would have a 12 to 15 digit number, as per international dialing schemes. The subscriber can specify the number and frequency of attempts that the system will try for message delivery.

A subscriber may authorize other users, not necessarily subscribers, to deposit messages in his mailbox by giving his mailbox number to them (call answering mode). This user would access the system the same way as a subscriber, however, he would need to input only the subscriber's mailbox number instead of an identification number. The length and number of messages that are allowed to be left this way may be constrained by the subscriber. A true answering service will be offered with the subscriber's own personal salutation and unique accessing method.

3.2 MESSAGE RETRIEVAL

To retrieve the messages left in his mailbox, a subscriber dials up the nearest VS&F access node and identifies himself by his customer I.D., as previously described. The subscriber is then informed by a system generated voice recording of the number of messages in his mailbox. He then has full control

over the message retrieval through DTMF signalling commands to listen, erase, replay, or skip messages.

Advanced features allow a subscriber to instruct the system to redirect a message to a third party, append a voice message prior to redirecting, or send a reply voice message to the sender without having to supply the sender's mailbox number.

3.3 MESSAGE BROADCASTING

A subscriber may prestore multiple lists of mailboxes. These lists are identified by a multiple-digit number. Instead of supplying a mailbox or off-net phone number as the destination for a message, the subscriber supplies a broadcast list number. The system will then deliver the same message to all the mailboxes or phone numbers on the list.

3.4 MESSAGE FORWARDING

A subscriber may substitute a DDD number, or other mailbox number, for his own mailbox for a predetermined period of time. During this period, any message going to his mailbox will be forwarded automatically. The subscriber can specify the number and frequency of attempts that the system will try for message delivery.

3.5 OTHER SERVICES

VS&F is part of the concept of an office of the future. With today's technology, an extensive list of products and services are available to improve productivity within the office, and to provide important work-related services to geographical locations outside the office. A partial list of advanced features under consideration for the VS&F system include:

- Image Messaging
- Text Messaging
- Voice Message Filing System
- Dictation/Word Processing
- Voice Advertising

4. INTERFACING

The VS&F system should be visualized as a single component or node in a communications network (see figure 5). From the communications viewpoint, an effective VS&F system must be able to interface both SPCC's SPRINT network, and the public network, plus allow inter-machine data communication directly with other VS&F systems. The public network would be

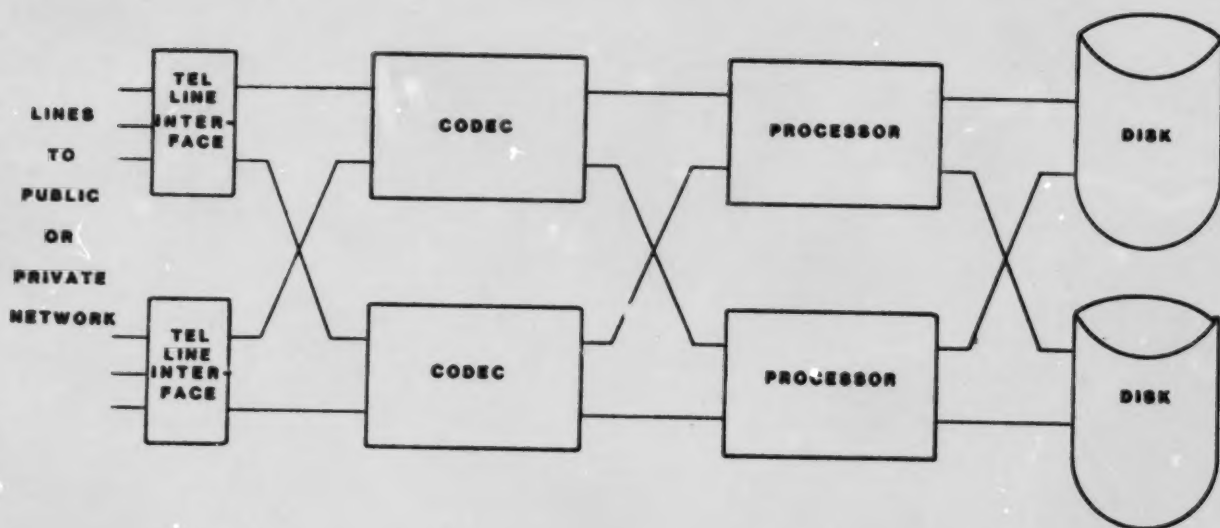


FIGURE 3
A TYPICAL VOICE STORE & FORWARD SYSTEM

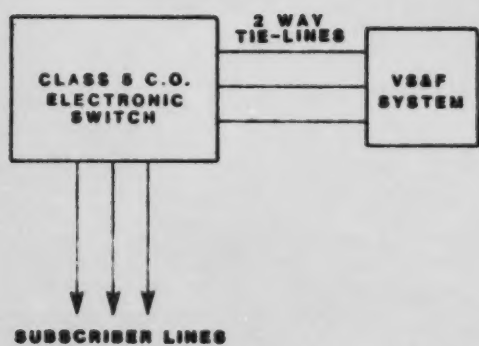


FIGURE 4A
INTERFACING A CLASS 5 C.O.
BY INTEGRATION

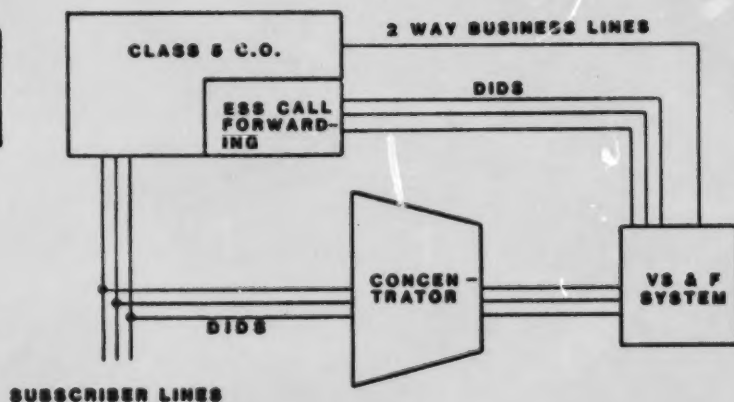


FIGURE 4B
INTERFACING A CLASS 5 C.O.
BY LINE TAPPING/CALL FORWARDING

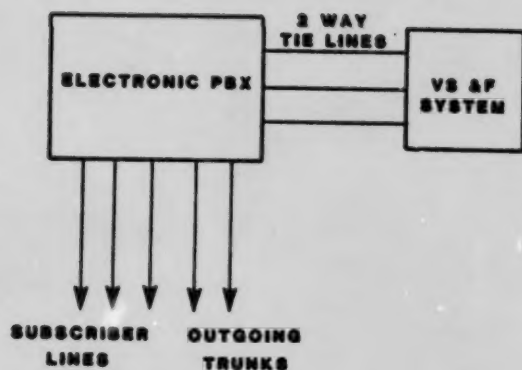


FIGURE 4C
INTERFACING WITH A PBX

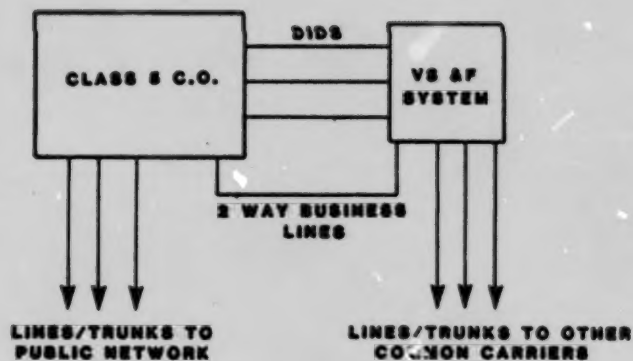


FIGURE 4D
INTERFACING TO CUSTOMERS AS A STAND ALONE
SYSTEM



FIGURE 5

used for local distribution and collection of messages - it provides the interface between our customer and the SPRINT or VS&F network. The SPRINT network would be used to support inter-city transmission of messages.

Access to SPCC VS&F service will be established initially in more than 100 cities across the United States. At the time a customer subscribes to the VS&F services, he would specify the city which he wishes to designate as the "logical" address for each VS&F mailbox to which he subscribes. This logical address is the customer's "access node". The actual storage of his messages will normally reside at the closest VS&F system. The location of this system will be the "physical" address of his mailbox(es) which is designated as the customer's "home node". The customer record exists in the database at his home node. This record contains all the information necessary for I.D. validation, emergency contact, billing, etc. Each VS&F node will have interfaces to both the public network and the SPCC SPRINT network. They will, in fact, become an integral part of the SPRINT network operated by SPCC. Such networking capability will allow voice messages to be recorded and forwarded nationwide at the least cost to the subscribers.

To support the network operations, five types of interfaces are proposed.

1. Direct Inward Dialing Lines (DID's)
2. Public Network Access Lines (PNAL's)
3. Dedicated Access Lines (DAL's)
4. Intermachine Trunk (IMT's)
5. Internode Data Link (IDL's)

These interfaces allow a VS&F system to become an integral part of the existing network (figure 6).

DID's are lines connecting the VS&F system to Class 5 Telco C.O. The DID's are used as incoming-only trunks to identify the called party for certain call answering applications.

PNAL's connect the VS&F node to a Class 5 Telco C.O., allowing both incoming or outgoing calls. They are used primarily by the system to place outgoing calls to local or remote phone numbers not served by the SPRINT network, and to receive requests for VS&F service from the local area.

DAL's allow a customer direct access to

a VS&F node without having to dial the local VS&F access phone number.

IMT's connect the VS&F node to the closest SPRINT switching facility. IMT's are two way trunks, used by the system to place outgoing calls to a DDD number served by the SPRINT network, and to receive VS&F requests for service from any city remote from the VS&F location. These trunks are also used to transfer voice messages between VS&F nodes.

The IDL's allow the VS&F centers in different geographic locations to communicate with each other. The data links are used primarily to allow one node to query another node's data base for customer and mailbox information.

The nodes communicate by packets conforming to CCITT X.25 standards. The data link access uses the principle and terminology of the High Level Data Link Control (HDLC) procedure. The interface between a node and the data links allows both permanent virtual circuits and switched virtual circuits conforming to the CCITT X.21 standard, and is capable of bit rates of 2.4 kb, 9.6 kb and 56 kb.

Data link connections allow the SPCC Network Control Center (NCC) to communicate with any node in the network for centralized maintenance and administration. Billing data are also transmitted from all the nodes to the NCC through the data links for centralized billing.

5. CONCLUSION

VS&F service is a natural extension of the services currently provided by SPCC. There is substantial benefit to the provider and the users of this service. To SPCC, the addition of a VS&F service should result in not only an absolute increase in the level of network usage, but also an improvement in SPRINT network efficiency through the introduction of extra traffic in off peak hours. To the consumer, this means substantial savings in long distance communication costs by carrying voice messages over the SPCC SPRINT network, and by reducing the number of direct call attempts to unavailable called parties.

ACKNOWLEDGEMENTS

We would like to thank George Vasilakos, and Rex Hollis, for their support and encouragement.

VS & F INTERFACES

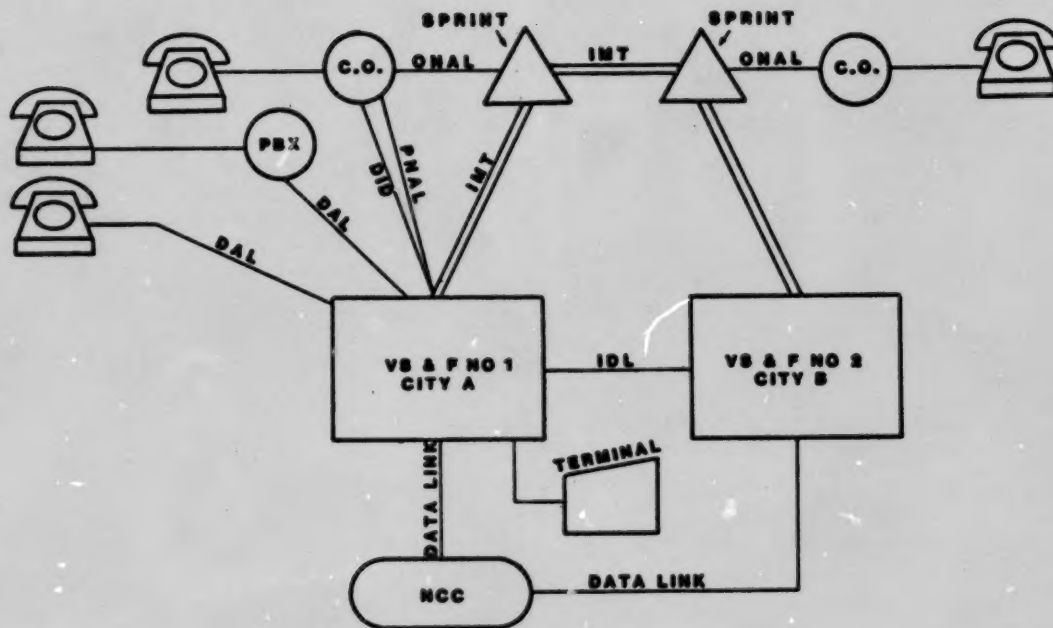


FIGURE 6
VS & F NETWORK INTERFACES

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Undersea Systems Technology Trends

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Abstract

A brief review of currently available analogue undersea system designs, and their application is presented. To meet the future demand for digital traffic undersea light guide cable systems are being developed. The availability of this new technology and the related advantages are considered.

Undersea telecommunications systems are now well established as one of the principal elements of the global network. This is clearly evident when the related investments made in underwater cable systems are examined in detail. Following some indecision during the early seventies, annual investment in this technology worldwide averaged more than 200 million Dollars. In fact, since 1974 some \$1.8 billion has been invested in cable systems to date. A further one billion dollars is already committed for projects now under construction for completion during 1982-84.

Apart from many regional cables installed around Europe, the Mediterranean Basin and South East Asia, there were several transoceanic systems completed since 1974. For example:

Service Date	Route
1974	CANTAT-2 (UK-Canada)
1974	HAW-3 (California-Hawaii)
1975	TPC-2 (Hawaii-Okinawa)
1976	TAT-6 (US-France)
1977	COLOMBUS (Spain-Venezuela)
1978	Philippines-Singapore
1980	BRUS (Brazil-Virgin Is)
1981	IOCOM (India-Malaysia)
1982	ATLANTIS (Brazil-Senegal-Portugal)
1983	TAT-7 (US-UK)
1984	ANZCAN (Australia/NZ-Hawaii-Canada)

Details of the most recent project - the ANZCAN system - have been discussed at this conference. The ANZCAN system represents an important development. The main link between Australia, Norfolk Island, Fiji, Hawaii and Canada is some 7500 n.m. (13,900 km) long. It traverses the whole Pacific Ocean, and at a time coincident with the fifth generation of INTELSAT satellites is regarded by many operating Administrations and countries as justified investment.

The main link will employ 14 MHz systems offering 23 Supergroup capacity. This capacity can be utilised for 1380 two-way circuits when equipped with conventional 4 KHz channelling, or 1840 circuits when more efficient 3 KHz special channelling equipment is provided.

While still on the subject of ANZCAN, a few technical points may be of interest. The main link will have 49,580 db loss at its highest operating frequency of 13.7 MHz. This represents a rate equivalent to 2.5×10 to the power of 4958.

Yes, 10 to the power of 4958 - a huge requirement to compensate for such a loss, initially with a close tolerance; followed by high stability over some 25 years. To achieve this task some 1033 repeaters, plus 65 equalisers will be placed at the bottom of the Pacific Ocean. Additionally, five sets of terminal equipments will be used to provide the necessary power supply, signal amplification, equalisation and multiplexing.

This is just an example of the loss - gain equation faced by the designers of undersea cable communication systems. It is in addition to long life requirements to maintain the quality of circuits for a span of 25 years.

Current system designs offer a whole range of circuit capacities from 8 to 69 supergroups. Recognising that one supergroup is equivalent to either 60 or 80 two-way channels, depending upon the multiplex arrangements, a whole range of designs offering 480 to 5520 channels is available for transoceanic distances. Clearly, the economy of scale principle is fully applicable to undersea systems, in that the bigger the system capacity, the lower is the cost per circuit. Of course, economy of scale is only valid when there is scale.

All the statistics indicate that the growth of international traffic is still high, in the range of 14-25% p.a., depending upon the relations, and the telecommunication maturity of the national and international networks of the countries involved. Such growth rates imply doubling of system capacity in three to five years.

Looking ahead, outline designs are available for undersea analogue systems with 180 supergroup capacity working at 140 MHz line frequency. Undoubtedly, such systems would be economic for high density routes suitable for such large traffic cross-section.

However, 140 MHz analogue systems are unlikely to be implemented since the recent trend in telecommunications is towards digital capability.

There are many reasons for this situation, and vigorous arguments prevail as to what is the cause, and what is the effect. The undisputed fact is that switching systems are changing to digital operation, local networks in many countries have been using PCM systems for many years, and several countries have long distance digital network overlays. Intelsat too is introducing TDMA as a part of its operational requirement to obtain more circuits from limited transponder bandwidths.

Extensive studies show that digital transmission on conventional coaxial undersea cables is not economic. But optical fibre cables (lightguides) offer exciting possibilities.

Sufficient design studies supported by laboratory evaluations have been undertaken to date on optical undersea cable systems to confirm the feasibility of this new technology.

The question is not if, but when optical fibre undersea systems will be available.

With every new technology it takes time to translate early laboratory experiments into mature engineering applications, especially in the field of high reliability engineering, as in the case of underwater cable systems.

There appears to be a consensus of opinion between the various countries having undersea cable system design capability that early experimental systems are likely to appear around 1984-85, followed by the first commercial applications on a regional basis some two years later.

The first transoceanic system is planned for 1988, and it is most likely to be the TAT-8 system between the U.S.A. and Europe. Soon afterwards an optical undersea cable system is expected to provide further relief for shortage of cable circuits between Hawaii and the Continental U.S. Of course, several other routes outside the U.S.A., especially in Europe, are early candidates for construction of undersea optical fibre systems.

Based upon the current view, this new technology is likely to offer several advantages. Besides being a natural digital transmission medium, it will offer:-

- Large capacity systems limited only by the specific route traffic requirements.
- Modular capacity using standard electronic modules, and variable numbers of fibre pairs in one cable structure for a given route.
- Enhanced system economics due to significantly increased repeater spacing for high capacity systems.
- Underwater branching units, which would allow two, or three separate landing points at both ends of the system.

- Ease of deploying digital speech interpolation (DSI) to increase significantly the total utilisation of the basic system bandwidth.

In order to achieve potential economic benefits of this new technology, undersea optical cables will use monomode fibres. The first systems are likely to operate at 1.3 micron wavelength. At this wavelength repeater spacing of some 30 Km is practical for operation at 140-280 Mbit/s per pair of fibres enclosed in a cable structure less than one inch in diameter.

Just to compare this with analogue systems of similar capacity, the spacing of an equivalent 140 Mbit/s system is some 13.5 Km when working with 1.5 inch cable. In the case of a 280 Mbit/s equivalent analogue system, repeaters have to be inserted every 5.4 km using 1.5 inch cable.

This is only just one example of the potential benefits offered by introduction of fibre optics for undersea telecommunications.

As with the case of land based systems, the transition to digital working, and to fibre optics will be gradual, and is likely to take best part of this decade.

Existing designs of analogue systems are being and will be ordered for some time yet. The ANZCAN project is a good example of this. Digital systems are perfect for digital traffic. Otherwise conversion of Analogue (A) to Digital (D), or D to A is necessary.

The world is gradually moving from A to D in all forms of telecommunication network operation and hardware. Undersea cable systems technology is also moving in that direction. Not only to keep abreast of the technological developments, but to maintain its competitive position as one of the principal elements of the global telecommunications network of the future.

A BANDWIDTH-EFFICIENT DATA TRANSMISSION SYSTEM

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Abstract

Theoretical and experimental studies have shown that it is possible to transmit out-of-baseband binary data at a rate of 2 bits per second per Hertz bandwidth, with zero intersymbol interference, and with a bit error rate equivalent to that of optimum CPSK and MSK. This scheme does not involve new principles, but results from an extension of principles which are normally reserved for baseband systems.

DISCUSSION

With the congestion of the electromagnetic spectrum, spectral efficiency often becomes the governing factor in the choice of a data transmission system. Spectrally efficient systems are those which maximize the number of bits per second which can be transmitted on a given bandwidth. Multilevel and multiphase coding are often used to provide greater spectral efficiency, but these steps almost invariably result in a penalty in terms of noise performance (1).

Limiting the bandwidth of binary data to a baseband signal bandwidth of half the bit rate results in a spectral efficiency of 2 bits per second per Hertz (2,3). An optimum system of this type, perturbed by additive white gaussian noise, has a probability of error P_e (4) which can be expressed as follows:

$$P_e = 1/2 \operatorname{erfc} \sqrt{E_b/N_0} \quad (1)$$

where E_b = signal energy per bit

$N_0/2$ = spectral density of the noise

The bit error rate performance of equation (1) represents an ideal system, and it assumes that the system conforms to Nyquist's I criterion for distortionless transmission; i.e., zero intersymbol interference at the data sampling points.

At this point in a conventional out-of-baseband system, the data stream is modulated on an rf carrier, thus in effect doubling the bandwidth, and halving the initial spectral efficiency.

In the new concept, rather than use NRS data to indicate "1's" and "0's", bipolar impulses are used. A bandpass filter with a bandwidth of half the bit rate is adjusted to extend from $nB/2$ to $(n+1)B/2$, where B is the bit rate and n is any positive integer. Total bandwidth is therefore $B/2$, and the output from the bandpass filter is used for transmission directly, in lieu of modulation.

In practice, of course, this efficient $B/2$ bandwidth can be translated up or down in frequency at will, for the sake of convenience, without disrupting the basic principles of the data transmission system. Spectral efficiency is thus retained at 2 bits per Hertz.

Signal detection at the receiver is by coherent demodulation, using a coherent reference frequency at either $nB/2$ or $(n+1)B/2$.

Figure 1 shows the performance of an ideal system in noise, assuming a rectangular passband. The second curve shows the simulated performance in BER for the new system, using practical, realizable filters. The impulse response for a realizable system is shown in Figure 2, while Figure 3 shows a typical eye pattern.

Bandwidth restriction in the new system is always in the receiver bandpass filter, and not in the demodulator. Ideal performance is therefore not at all incompatible with bandwidth conservation. In some systems, such as those which use an integrate-and-dump detector, ideal performance is obtainable only if the receiver itself has a relatively wide bandwidth; i.e., several times as wide as the "matched" bandwidth of the demodulator itself.

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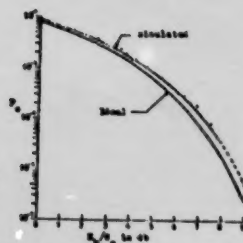


Figure 1: Comparison of Ideal BER performance with that of the new system.



Figure 2: Typical impulse response for the new system.

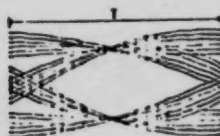


Figure 3: Typical eye pattern for the new system, using coherent demodulation.

Developing
Telecommunications
Services:
Emerging Business
and User
Opportunities

Opportunities Presented by
the New Telecommunications Services

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Abstract:

From independent product developments motivated by a number of national needs to provide better office operation and inter-office communications, we have observed the emerging of a variety of new products and facilities. The need for compatibility among these products, with the associated communications facilities, and with earlier and future products and services is stressed. From the standpoint of the business, personal, academic, and government entity users, issues of availability, connectivity and future growth are discussed.

1. INTRODUCTION

Over the last several decades there has been a growing interweaving of the science of computation and information processing with the science of telecommunications. Communications in the form of voice, data, record, video and facsimile have been applied to business systems generally on a link by link basis with terminals or subscribers sets at both ends of the link. As the system became more complex, the links became networks and switching nodes were placed between some of the links not directly connected to a subscribers station. Meanwhile, information processing emerged from the back room where it was handled by specialists, to widespread use at application terminals. This took the form of keyboard inputs, video verification, facsimile, and hard copy inputs, plus outputs on screens, hard copy, and facsimile devices.

During this period, the lowering costs of memory devices enabled processing systems to not only perform computation, rearrangement or reformatting of data, but to store much of it for subsequent use, and combine data of yesterday and earlier with future information when it became available.

Consequently, this increased demand for data processing and access to stored information created a need for connection between the various users and the processing equipment, namely: telecommunications links.

The telecommunications services we wish to discuss are those services which grew out of those primitive beginnings and we wish to recognize what they are, how they developed over the past five years, and when they will be commercially available to the users in the near future.

2. DEFINITION AND DESCRIPTION OF
TELEMATIC SERVICES

The last study period of the CCITT, particularly in Study Group VIII, produced tremendous progress in developing various standards, that is, recom-

mendations dealing with Teletex, Videotex and other services.

Their work was recognized at the VIIth Plenary November 1980, which merged Study Groups VIII and XIV, namely, dealing with alphanumeric type of machines and terminals with the facsimile terminals. Correspondingly, in the ISO, business terminals were treated and the protocols for interconnecting them were advanced in development in several subcommittees of TC97, particularly, SC6, SC16 and the newly formed SC18. With these kinds of interactions, it is now apparent that a user can acquire for his purposes a complete end-to-end service from some communications common carriers and he can also construct, from commercially available data processing equipment, and specialized communications connections, a network that suits his purposes, traffic needs and geographic dispersion. That precisely is Telematic services. The term itself was generated by a translation from the French "telematique"; the discussions at the CCITT VIIth Plenary in November 1980, selected the term "telematic" instead of "teleinformatic" for reasons of trademarks, proprietary product designations and similar excessively precise identification. Each Telematic service is defined in the specific Recommendation that applies to it and we refer you to the Yellow Book of the CCITT for descriptions of these recommendations, as well as more precise explanation of the titles. Our explanations here will be semi-popular. That the user needs information as the ultimate end product is the underlying idea even though the information root does not appear. In the term itself, the prefix "tele" is useful in that it implies separation between cooperating parties (sending and receiving or recording).

Although the term does not imply a networking arrangement, in practice, there is a multiplicity of senders and receivers as well as intermediary functionaries; and so a network is almost always a key ingredient of the Telematic service.

Finally, the word "service"; for this definition, the PTT's or common carriers provide a tariffed service with the price of equipment essentially on a rental basis.

For comparison, the telephone voice service that we are all familiar with involves an extremely complex network of central offices, tandem trunk offices, network management offices, microwave links, plain copper lines, perhaps a satellite or two and some end-instruments such as terminals or subscriber sets. The service is that you can talk to a selected person, properly equipped with a terminal, of course, and be billed for the amount of service the network and terminals have given you. Connect time, number of packets of information, distance, and so forth are criteria that establish the price. Now this is all very fundamental, yet it is analogous to the Telematic types of tariff. Here, speed of transmission, the duration of connect time, or number of pieces of information sent, are tariff factors, as are the route and distance over which the data is sent. Still other factors associated with some of the data aspects are whether the user is ready and the amount of network utilized trying to determine whether he is ready and connectable. Those things are a few new ideas, variations on how the price of service is established. Nevertheless, the provider of these services takes full responsibility end-to-end.

There should be no quarrel with a common carrier providing any such services; in fact, we encourage all PTTs to provide this service wherever they perceive a market. On the other hand, the data processing industry believes that innovation in office practices occurs only when the user has an opportunity to change his procedures or his operations to suit his needs best and to do them under his own control. He also should have the option to recognize that he erred, and can return to a previous type of operation. Or perhaps to use different procedures in different circumstances. To preserve this flexibility and the ability to innovate, we feel there must be an alternative to the end-to-end services that users sometimes reluctantly accept.

So the purpose of this paper is to inform the user of the options offered by the data processing services as well as the common carrier services to enable him to achieve the Telematic service best suited to his needs. I think that all of us can operate more efficiently when we know these alternatives are available and that they will improve our performance as time goes on because of the competition that we give each other.

3. GROSS CHARACTERISTICS OF NEW AND OLD SERVICES

The services I will discuss are those offered by the authorized common carrier (PTT or RPOA), and those commercial offerings by suppliers in the information industry. Table 1 lists the principal services we intend to treat; Table 2, the information industry vendors in this field. Some of the suppliers have assembled Telematic systems using Local Area Networks to interconnect their own processor and terminal configurations; others have utilized PTT/RPOA circuits and facilities to

interconnect their products. PTT's have employed new CCITT Recommendations (e.g., S62) to specify and design end-to-end receivers. Table 3 gives some of the PTT's who have announced Teletex offerings in the early 1980's while Table 4 lists those offering Videotex.

Table 1. Sample List of PTT Services/Terminals

Old	New
Telex	Videotex
Facsimile Telegraph	Teletex
	Bureau Fax
	Teletext (Broadcast)

Table 2. Sample List of Telematic Suppliers

LANIER	DEC
XEROX	A.B. DICK
OLIVETTI	PHILLIPS
IBM	WANG
DATAPoint	VYDEC
AM INT'L	CPT
BURROUGHS	LEXITRON
EXXON	

Table 3. Sample List of Teletex Offerings (PTT's)

Federal Republic of Germany	Switzerland
France	United Kingdom
Sweden	Norway
Italy	Canada
Japan	U.S.A. (RPOA)

Table 4. Sample Videotex Offerings

UK - Prestel
France - Antiope
German Federal Republic - Bildschirmtex
Japan - Captain
Canada - Telidon
U.S.A. - some Prestel, some Telidon, AT&T designs/trials

The "old" services, provided on an "end-to-end" basis by PTTs, consisted of character or pixel oriented data communication utilizing essentially telegraph type transmission and switching facilities. "Old" services from the information industry basically were single application oriented using low or medium speed terminals and leased line voice grade transmission facilities.

The "new" services handle information much faster, with higher speed components, and have many more features. Table 5 compares some of the key characteristics of new and old services. Table 6 amplifies the systems characteristics of the Videotex service, most of which are not provided in the older services.

Table 5. Comparison of Key Characteristics of New and Old Telecommunication Services

Characteristic	Old	New
Keyboard	44 or fewer keys	48 or more keys
	Alphanumeric	Alphanumeric, operator, control
	Single shift	Double shift
	Mechanical	Electronic
Character Code	5 level Baudot	8 level, 8 bit/char.
	Control by alpha combination	Controls in alphabet.
	No graphic	Graphic & escapes
Transmission Speed	50, 100, 112, 150, 200, 300 bd	600, 1200 9600 bps
	Asynchronous	Synchronous
Screen	None	Teletex Video-text: 2000 characters
Work Station Clusters	No	Yes

Table 6. Systems Characteristics on Videotex Terminals

- Full alphanumeric keyboard
- Off-line frame storage (floppy disk, tape)
- Hard-copy print-out of frames
- Editing facilities to modify or create frames
- Software to extract data from videotex frames, for use by application programs
- Telesoftware
- Graphic displays
- Intelligent nodes in distributed processing systems
- Transaction processing (e.g., purchasing goods services)
- Electronic mail (including Telex interface)
- "Remote office" support

In order to concentrate on the impact of the new services, and the opportunities to use them, I will only treat the application opportunities as they appear in Videotex services, and there as the central and remote offices or work stations benefit from high speed communications, rapid establishment of connection, new functions that each member of the office staff can use, and how an employee, be he manager, "knowledge worker," or clerk, can work at home or some other remote location. Tables 7, 8, and 9 list these features. Note in table 7, that a new role has been established. The "information provider" can perform a service and supply equipment which serves a multiplicity of subscribers or users, and which also serves a number of sources of information -- in a dynamic way.

Table 7. Office Automation Applications Using New Telematic Services

- Modelling
- Word processing
- Electronic mail
- Messaging/teleconferencing
- Electronic index card files
- Computerized calendar/diary
- Table processing and maintenance
- Intelligent-editing terminal
- Software development
- Intelligent data processing terminal
- Home processing
- Inquiry and retrieval
- Transaction processing, data collection
- Interactive publishing
- Presentation development tools
- Software distribution and support

Table 8. Information Provider Files

- User guides to use services
- Service charging schedules
- Directories (telephones, addresses, etc.)
- Catalogs (e.g., inventories, prices)
- Specifications (e.g., products)
- Status information (e.g., products, budgets accounts, availability).
- Transportation
- Entertainment
- Shopping/ordering
- Bill paying/banking
- User created files
- Computer assisted instruction (staff training, software documentation).
- Data collection (e.g., surveys)

Table 9. Benefits of the Remote Office and Home Processing Services

- Knowledge workers can use the office whenever it is convenient for them, not just during normal office hours
- Meeting away from the office and sales visits can be made more productive, by permitting staff to have full access to their organization's information resources
- Productivity is increased by permitting staff to work during times that would have been idle, especially during business travel
- Knowledge workers can work at home more effectively on certain tasks, for example, in assignments involving communication with staff or clients in different time zones.

4. DISTINGUISHING DIFFERENCES WHICH CAN LEAD TO INCOMPATIBILITY

Although the older services in place today are less effective than the new Telematic services, they still may be completely adequate for many users and for a long time in the future. If they are not, then transition is an extremely difficult problem for a user to cope with. He must maintain return on investment from the old equipment and he must get enough additional performance from the new so that it justifies a likely higher price of the newly installed equipment. Generally, there is a period when both new and old are on the same network. We see from the gross characteristics that were given on the several services that in the case of coded character transmission, the nature of the character has changed from telex with the 5-level Baudot character structure and assemblage of signal elements to Teletex, an 8-level generally synchronous type of transmission in which not only is the 8-level complete with all eight bits involved in data, but that there are extensions to the alphabet so that special graphical considerations and alphabets of many languages can be catered to in the new services. Transmission speeds are also higher. In telex service, transmission characteristics usually are 50 baud except where they are concentrated within common carrier networks. Subscribers usually have no interest in perpetuating telex at higher speeds.

In facsimile, group one machines are generally incompatible with anything else, but group two and group three machines can operate with each other on the same analog public switched telephone network by the use of proper modems, provided the group three machines operate at the group two (lower) speeds.

Group four, being digital, represents a departure again from groups two and three. So as we make use of higher performance devices in the facsimile family, we have certain incompatibilities that prevent their fully interworking. The links themselves have similar problems in terms of disconnect characteristics, in-band signalling, electrical conversions from analog to digital and vice versa, as well as in the switching and data base area. In general, the attempt to maintain compatibility between new and old involves sacrificing some of the higher performance in order to preserve the connection interface, code, or other features that let two devices talk to each other or at least indicate the fact that they cannot talk to each other.

5. THE ECONOMIC NEED FOR COMPATIBILITY

A point I wish to make is that, from an economic sense, it is extremely desirable to provide the compatibility for transition and for long periods of interworking with new and old equipment, even at the expense of maximum performance of some of the new devices. Incompatibility can seriously impair the opportunity for business expansion.

Technically we would like to throw out the old, supplant it with the new. Economically, we are not going to pick up as many subscribers if we follow that strategy. From a business and economic standpoint, there should be a smooth transition from the old to the new services.

Using word processing as an example, we have found that at least a dozen major suppliers, independently working up a word processing system to service an office, would assemble a number of typing and screen stations that perhaps would interface with a data base; there would also be a heterogeneous collection of output printers and various hierarchies of storage with slower or faster retrieval, depending on the amount to be stored.

It is almost safe to say that among all the manufacturers in the U.S., some portions of the English language were only thing they had in common. The shape of the characters, the quality of the printing, the layout of the screen, the presence or absence of data communications, the interconnection between numerous transcribing stations have all been different. Many word-processing manufacturers, have exploited differences in an effort to discourage competitors, but users are not pleased because they are forced to deal with a single supplier.

Several suppliers in the Teletex area have gone down the same road. You might ask, why doesn't the user make his needs known earlier, why doesn't he take the lead and dictate requirements to a standards body? As a chairman of a key ISO Standards body (TC97/SC6) I would be very happy to generate such standards. And my answer is yes, they're doing that. Users are making their requirements known but they are also cautious. They can call for a very expensive custom design -- they like feedback from the builders -- if I ask for this, how much would it cost me? If I ask for that in its place, would it be cheaper? Would this do it faster? Would it be more reliable? And so there is interplay between the users and the manufacturers and yet, I have to report that we are only beginning to get a sufficiently well-anchored approach toward compatibility mix and match in these areas.

Last year I spoke on standards -- I don't intend to do that now. I would like to point out that the concept of Open Systems Interconnection; namely, allowing one subscriber to talk to any other compatible subscriber, through specified telecommunication facilities and data processing centers, provides an environment in which this compatibility can thrive and be applied most effectively.

The structure of X.25 is another example of how putting the right function at the right place allows a number of different telecommunications services to transport the information from one place or another, even though the user has formulated the information for transmission in one single manner. Some of the options provided by ISO TC97/SC6 allow different applications to

transmit with greater efficiency for their particular application while other options will do the reverse.

Work is now going on in ISO TC97/16 which will allow the user to select the options and at a lower level allow the carrier to select the transmission facilities and thus optimize the networks. The general concepts of the ISDN, the Integrated Services Digital Network, will do much to permit the investment of telecommunications facilities to be useful for all of these users' traffic needs. The taxpayers who have provided these facilities in many of the developed countries can continue to use them for the physical life of the product and not have to be concerned by system considerations.

An important feature of achieving compatibility is the transmission characteristics, as well as the switching and management nodes of the ISDN. Basically, the ISDN is a backbone of 64 Kbps data circuits (Some may be digital, some analog, but all are able to handle 64 Kbps digital data traffic.) The nodes apply code conversion, speed conversion, buffering, resynchronizing, and conversion, of any other systems parameters peculiar to each subscriber's native mode.

No converter or adjuster can create information. A lower performance feeder can have his data passed to a higher performance receiver. However, the high performer, when sending, must have his traffic squeezed and partially lost when the lower performance receiver can't handle it.

6. THE ROLE OF LOCAL AREA NETWORKS

I would like to look briefly at those applications where local area networks press for improvement in office telecommunications which occur on a limited scale. Visualize a manufacturing organization which comprises work stations for production control, each station scattered over perhaps one-half acre of manufacturing space, certain concentrations of supervisory locations, and groups of spacious executive offices. Visualize also, engineering operations with extensive laboratory space, drafting rooms and supervisory locations, cells where small engineering teams are located, as well as their top management's quarters. Or a sales organization where we now have a greater degree of separation of service cells and statistical reporting locations, but at some distances from sales headquarters offices.

All of the spaces involved are likely to be contiguous; and, in all three illustrations, they are likely to be in one building. The building may be a large single level structure common to manufacturing plants, or it might be a high rise which is more likely for a sales office, with the engineering building represented somewhere between the other two. The premises are controlled by the user; and he provides wire interconnections between all of his terminals, using digital or analog information or communications

techniques, with or without any switching. This situation has led in some areas to a Local Area Network (LAN) concept being developed; sometimes where high speed communications techniques have been employed.

In order to proceed with the orderly standardization of local area networks, a definition was developed in the special ad hoc committee of ISO last summer: "A Local Area Network is a network used for the serial communication of information between interconnected independent devices and is completely under the jurisdiction and is limited to being used within a users premises." By the phrase "serial communication," certain functions such as machine tool control in a manufacturing function, a very specialized utilization of information, are excluded from the local area network. The central place where the machine tool is kept is usually remote from the machine tool itself and the program is usually generated separately, i.e., "off-line." So here is an internal network where tariff services are a nonrequirement.

The constriction of the technology to I/O interface approaches, that is within the data processing collection of equipments, is implied by "information between independent devices," independent being the key word. So while this definition is not entirely precise, it tries to demarcate a unified, dispersed data processing system — not dispersed too widely, yet one that deals with some system interconnections. While that definition was being considered, the discussion concerning it was aided greatly by a diagram (Figure 1). One of the devices interconnected was a modem or port to telecommunications (public) facilities, because it was recognized that any user having an operation this complicated, probably wishes to converse with other similar or associated organizations. For instance, the manufacturing plant may have to deal with the engineering staff who are inclined to revise their design. The sales headquarters may have to deal with their remote branches, warehouses or modification centers.

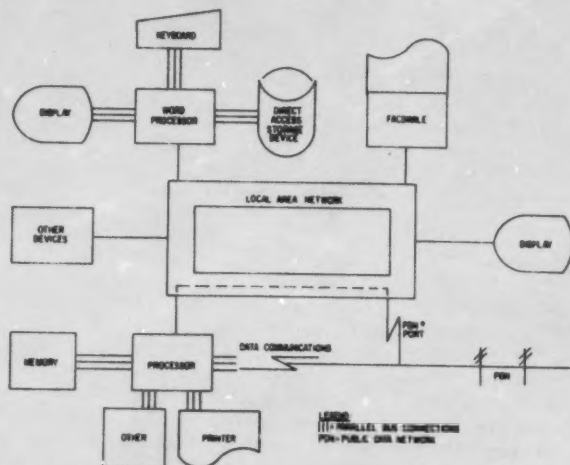


Figure 1. Local Area Network Reference Diagram

And so we have Local Area Networks being of interest to PTC, not because of their exclusive application, but rather their interface with public telecommunications facilities. Just to illustrate the parameters that are needed to create the Local Area Networks, Table 10 characterizes a Local Area Network, the parameters not being exclusive thereto, but it shows the number of factors to be considered.

Table 10. Local Area Network Standardization

<u>Standardization Area</u>	<u>Subcommittee Assignment</u>
<u>Architectural</u> <u>(OSI Applicability)</u>	
Privacy/Security/Encryption	97/WG 1 - 97/SC16
LAN-Reference Model	97/SC16
<u>Communications</u> <u>(OSI I, II, III)</u>	
Topology	97/SC6
Data Rates Classification	97/SC6
Transfer Path (Distance/Separation)	97/SC6
Protocols-Access Methods	97/SC6
Accountability/ Acknowledgement	97/SC6
Error Rate	97/SC6
Interconnection with other Networks	97/SC6
<u>Device Interconnection</u> <u>(OSI I, II)</u>	97/SC6/SC13
Network Considerations	
Device Considerations	
<u>Transmission Medium (OSI N/A)</u>	IEC/CCITT

6.1 MIGRATION

One example of a user-designed, information industry implemented application-oriented network is SWIFT (which stands for the Society for Worldwide Interbank Financial Telecommunications). SWIFT basically started as a message switching system with strategically located concentrators, the strategy involving technically oriented considerations, political considerations, and economic considerations, which relate to traffic, speed of response, reliability, etc.

Initially, provisions were made for banks who had telex terminals in their offices to connect to the SWIFT network by these telex terminals. We recognized that many other banks, larger banks with many branches, were going to utilize higher speed and higher volume terminal connections and so a terminal called "SID"; SWIFT Interface Device, was specified by SWIFT Management and put out for bid, resulting in three suppliers being qualified to supply these devices. Simultaneously, SWIFT conceived that certain large banks would have data processing capability of their own and they would wish to utilize a direct connection between such data processors and their network. And so the class called CB; Computer Based Terminal that is, the computer itself, with the proper port, meeting SWIFT's standards for transmission, reception and response to transmission, was established. More and more, banks are using their major Computer Based Terminals instead of the lower speed telex and SID terminals.

This trend has been so pronounced over the last few years that we are now within a year of SWIFT discontinuing telex entirely. SWIFT, therefore, is an example where the economic advantages of compatibility or the economic disadvantages of incompatibility, a better way to express it, were measured and the technical alternatives provided so that both the old and new could coexist. The old is now superseded and therefore, migration to the new is proceeding. Why and when should there be migration? When it is economically feasible to migrate, that is, when it does all the things the old ever did, does them better, less costly, and there are enough operators to satisfy the user community need for this service.

6.2 USER CHOICE OF SUPPLIER

Now let us look at the economic issues that arise when the user has a choice of a self-provided or data processing service versus PTC end-to-end service provided networks. Different facilities would be used, as well as different end devices. For the moment, let us assume that all of these services are priced in a fair economic way, closely related to their costs.

The user may want to select the facility that slants the cost in his favor, whereas the carrier may wish to do it for his own convenience, based on loading, age of facilities, other customers to whom he may wish to give more attention.

There is a social point that the user should have the right to select facilities for cost as well as for performance. Therefore, with technical stability and tariffs established, quality of service and price should be the primary factors to determine what facility is selected. Finally, giving the user the opportunity to select which telecommunications service he desires involves business, social and perhaps even political decisions.

6.3 SOCIAL AND POLICY QUESTIONS

The user cannot act irresponsibly when he engages telecommunications facilities which may be a national asset not to be employed without careful consideration of the entire population or the political entity involved. These aspects may involve the ability to change tariffs to reflect usage, the ability to avoid the use of overloaded facilities, and availability of facilities; all factors that affect the user's choice of telecommunication resources. For example, a user may be able to transmit all his data over an old digital network. This may be interfere with digital facsimile traffic and so the assignment of digital telecommunication links must be examined. Or he might put all of his data on broadband multiplexed voice facilities -- that's fine, there's enough of those facilities to cater to all users. In another instance, a carrier may want to keep data off facsimile traffic, away from basically the analog transmission facility. The complexity of interacting multiple choices produces many economic benefits, but it also creates many problems of responsibility. Still, the opportunity is present for a user to devise a network unique to his requirements, buy equipment off the shelf, use tariffed services, and immediately start his operation, because of the forethought for having provided that compatibility.

6.4 SUPPLIER TRADE-OFFS

We wish by this paper to encourage users to participate, to discuss their business and communications needs with the suppliers that are particularly competent in the Pacific basin with its unique geographic and traffic volume considerations. And we wish to intelligently address the paper to the planners for developing entities that maximize compatibility so that older facilities will be able to live out their service life to the fullest. A wise investment of more diversified gear may be the right solution on many such developing entities.

7. WHERE IS THE DATA BASE? THE "INFORMATION PROVIDER"

Now we direct your attention to the question of the data base. When we had an isolated data processing installation, operations were simplified and restricted. A single data processing equipment supplier provided whatever memory we needed for storage--tapes, cores, disks. Later, when some of the storage devices became of interest to plug compatible manufacturers as well, we found that storage subsystems were being created and that their relationship to data processing was on a new basis -- an independent package which could be physically moved to another location and put on different data processors. More recently, we have found when the data base takes on an archival rather than intransit storage characteristic, that this data base has been produced by a new functionary; namely, the

"Data Base Provider" and that he is not just an equipment supplier, he is an operator of the data base and offers a service.

As an example, the service that allows remote shopping would involve a catalog maker, as well as one or more merchants. In its application, Mrs. Smith dials a screen presentation to determine the characteristic of the services offered. If food shopping is one such service, she may have four supermarkets to choose from -- the terminal tells her. She picks one of the four. Since the display can't possibly show all the items that are stocked, it asks, "would you like to select canned goods or dairy products first, and if canned goods, would you like vegetables or fruit juices or whatever?"

And so she goes down the list of product categories, specifics, brand names, quantities, perhaps forgetting an item and coming back to it, perhaps doing a comparison, should I get frozen green beans or canned, should I shop for staples at one location, go to a different butcher for meat?

All these things represent to a large extent what a Data Base Provider can accumulate in the way of general knowledge. It may be several suppliers of canned foods, several packing houses, or whatever, and so the data base provider's function is essentially to prepare the material for the user to select. As another example, a Data Base Provider can produce a transportation service with inputs from each common carrier, steamship line, airline or bus system; note their schedules and provide for accumulation of their loading. Of course, those suppliers may also wish to record the data base and get feedback in an effort to determine what use is being made of their data by the Data Base Provider. However, I am sure that the data processing industry can provide these items almost on a catalog basis as they do most of their other operators. I'm equally sure they would sell the service directly to the renters and users or to a conventional third party lessor. I am also confident that the design concept of a particular data base subsystem can be developed by a common carrier or that he could buy it and integrate it in with his stored program central office.

8. ROLES OF INFORMATION INDUSTRY MANUFACTURERS, COMMON CARRIERS AND INFORMATION PROVIDERS

This paper does not debate the issue of whether the common carrier is entering the field of data processing or whether the data processor is communicating.

I wish to point out that both paths are technically feasible and economically reasonable and that there is a third organization that may be economically superior in some cases: that of the independent Data Base Provider. One reason for this is the data base management. Where does the information come from? Who keeps it up to date? With the multiplicity of users, it is unlikely to

be the user and generally cannot be any single user. Certainly it should not be equipment suppliers -- they prefer to be transparent and unique and as undisturbed as possible by explicit application information. Since users have different applications or different stages of the data, their performance of these tasks may be biased or less than acceptable. In fact, a subscriber may not wish to have his competitor upgrade his data base. My point here is that the Data Base Provider is a third agency which the end users may have an opportunity to include in the end-to-end telecommunications services.

Finally, where is the data base physically located? As I mentioned, it can be installed amid data processing equipment, it can be technically included with a stored program central office or a switch; but it might also be a third location more convenient to the Data Base Provider. Furthermore, an additional plus factor for the Data Base Provider is that the data base management system represents a major field of software. Many companies specialize in writing software for data base management alone. In the last few years, we know that there are a number of good systems in the marketplace, but as data grows, the challenge to improve these systems will also grow and as it becomes more and more socially and politically necessary to isolate data bases belonging to different groups and organizations, the art of software development for data bases will become another growth opportunity.

In summary, I wish to state that telecommunications services have grown in the last five years through the efforts of individual suppliers and carriers to create end-to-end service, higher performance capability, and to make harmonious utilization of older, newer and diverse end instruments, transmission facilities and means of interconnecting them. This is being done to satisfy ever-growing user innovation applications. With these technological advancements, the user must be given the option to choose what fits his needs best. We, as suppliers, operators and governments must never stifle his ability to make experimental assemblages of systems that support continuing technological growth and continuing availability of products. We have pointed out a few of the unique emerging opportunities of the Pacific Basin and we have attempted to point out some of the social and political problems that can arise, that the user must be aware of as he makes his selection of his systems.

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Developing
Telecommunications
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STRATEGIES IN RESPONSE TO THE INTERNATIONAL INFORMATION REGIME:
Lessons and Advice to the Pacific Region

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A Second Industrial Revolution?

Can the Information Revolution reverse the trends of unequal development, begun during the sixteenth century with the advent of capitalism and solidified by the Industrial Revolution? This question places the transborder data flow issues squarely in the development context. The international trade system is undergoing a unique transition; "Telematique" (to use the very appropriate French term), the linking of computers and telecommunications are responsible for fundamental changes in the practice of international relations. It has created a new locus of wealth around the production and distribution of information. This unique resource--information--given force and speed by the communication and computer technologies, promises to alter the way in which nations interact, organize their affairs, plan recreation, manage their environment and determine and select among political, economic and social options.

The information revolution represents one of those significant periods in history when the possibilities for change are escalated by a shift in the base of societal organization. Actors are forced into competition for survival; elites can no longer depend on their control of traditional resources to reinforce their positions. New occupations result in new classes. As society attempts to hammer out some rules for maintaining functional stability, its very fabric is transformed.

There are no guarantees that more equitable international as well as domestic systems will result. Information technologies are viewed by some as the new, stronger links binding the "global village"--an impetus to an interdependent (cooperative) world. It is just as likely that the transition in the international system will represent yet another phase in the dependency cycle. Some have argued that the information revolution is not change in the sense of a structural crisis of authority; finance dependence, the name given to the debt-burden problems of the less developed countries, will simply be replaced by information dependence. A post industrial division of labor will provide different mechanisms for unequal development and the core/periphery structure of the last five hundred years will remain intact. Whether or not less developed nations will be able to benefit from this transition depends on a number of factors. Will they be able to effect corresponding changes in the composition of their labor forces and fulfill the need for information workers? Can satisfactory terms of access to Western data banks be negotiated? Will a safe threshold be established for

regulating the tradeoff between cultural imperatives and the need for modern technologies?

States must respond to the transition in the international system with carefully constructed information strategies; only then will they be able to successfully exploit the new conditions. It is the argument of this paper that success, to some degree, is possible given the nature of information and the telecommunications and computing technologies.

The International Information Regime

The information revolution has increased the variety and range of challenges to which states must react. This increases the drain on their capabilities and creates increased tensions surrounding their interactions. The search for viable response mechanisms is leading to an international information regime, composed of formal and informal practices designed to reduce this tension by lessening the impacts of information (data) exchanges. This can and has led to the imposition of limits on trading partners (tariff and non-tariff barriers) and to extensions of government powers within the challenged nations. At present, the emerging international information regime is at an early stage. The ultimate shape of the regime will either show biases in favor of traditional core countries or reflect a dramatic shift in the developing (and newly industrialized) nations' capabilities stemming from the information revolution. The information strategies of nations will play a crucial role and make the difference.

In order to appreciate this, the conditions and responses producing the international information regime must be explored. This will lay the groundwork for several case studies investigating the progress of today's apparent information strategies. The objective is to determine whether the states examined are fully realizing the opportunities created by the information revolution.

The Information Revolution

The information revolution is a process of transition that is:

- changing society by creating new actors, increasing the power of some, and decreasing the power of others;
- raising new sets of issues requiring attention, including questions about the use, production, distribution and storage of information. Some of the new issues can be seen in the privacy laws promulgated, restrictions on data flows through

- the use of tariff and non-tariff barriers, concern about cultural impacts stemming from unregulated information transfers, worker displacement and so forth, and
- resulting in new and controversial types of responses, in other words, new rules of the game are emerging.

There are two major sources of evidence for this assessment. The first is the nature, speed, and volume of transborder data flows, and the second is the response provoked by the resultant increase in data exchanges. The impacts of the present volume of data exchanges result from the technological capabilities that provide the force and speed of the phenomena and the very nature of information as a central, organizing resource.

The semi-conductor and the large scale integration technologies of the 1970s set off a microprocessor revolution that reduced the size and cost of computers and launched a boom in information services. Individuals now access and gather new kinds of knowledge; microcomputers are used for everything from personal finance to making travel arrangements to controlling production processes. It is predicted that the day may not be far off when an individual will leave the house only for those recreational activities which the computer cannot supply. Further, with organizational tasks being done at home through computer-communications networks, new kinds of urban centers, significant decreases in traffic noise and pollution, etc. are all possibilities for the future.

The search for ways to liberate activities from the constraints of time and place has led to the linkage of computer technologies with the telecommunications technologies--to information networks. The computer linked by terrestrial networks to satellites make possible world-wide information exchanges. Pool has pointed out that "History in evaluating our era may well view as one of its signal achievements the erosion of economic and technological barriers to the instantaneous exchange of information among persons who are far removed from each other and regardless of frontiers. Since communication costs by satellite have become essentially insensitive to distance and transmission time no longer a barrier to interaction, unprecedented opportunities arise."

In the history of communications the technological advances of the computer, the satellite and so forth follows historical patterns of change. Many of the present concerns are mirrored in earlier ages; maintaining the channels of communication, the need for skilled information workers, shortages, costs, the consequences of unrestricted information and news flows--all affected previous civilizations. The Emperor Tiberius of Rome was forced to establish a senatorial commission to ration papyrus when its lack threatened the workings of the Roman bureaucracy. Commenting on the impacts of radio, it was said that "Unlike the older means of transportation and communication such as maritime

shipping...postal communication and, indeed, the older branches of telecommunications which afford a more or less stable basis for international relations, radio-communications are in a state of rapid development with which it is hardly possible to keep pace." The same statement has been made often in connection with the technologies producing transborder data flows.

What makes the present unique is the nature of information as a central organizing unit of energy. Its properties can be summarized as follows:

- Information as a resource is essential to the proper functioning of other resources. Knowledge acquired in any number of "natural" ways is always needed for the application and assessment of resources. It is not proprietary, in the sense of oil or coal.
- It is the only resource that does not diminish through sharing. Rather, value is added by new users. This is especially true of large information networks.
- Information can also be a commodity. It can be created and sold. When not brought into the marketplace, it is "knowledge," an immeasurable but apparently necessary concomitant of human progress.
- Its power and impacts can be seen most clearly in decisionmaking. This involved everything from political bargaining to the individual's search for the best dollar value, to management's judgment of a prospective employee. Those who control this information, as well as its distribution, are the powerful and are creating a new information class in society.
- Information brings with it a new type of vulnerability. There is no aspect of life which can be isolated from the need for information exchanges. Further, there is no resource capable of taking its place should those exchanges be constricted or halted.
- It is dynamic. It is perhaps the only resource that cannot be removed from the context of exchange. No matter the method or the character of a transaction, information is involved.
- Information brings with it the possibility of unlimited growth to society since it cannot be diminished or completely controlled (especially as knowledge). Indeed, it tends to generate further information, knowledge, and innovation.
- It is self-regulating and self organizing. Information of one type can be used to coordinate other types of information.

Clearly, information is unlike any resource previously used to organize a division of labor. Its dual nature is confusing. It is both "knowledge," necessary for every type of transaction; and it is a commodity. No one is quite sure what

this means, what it will mean, what the resource should cost or the conditions under which its greatest benefits can be derived. Knowledge has unlimited growth potential. Will information have the same effect within the marketplace? Knowledge is nonproprietary. Will control of information rest outside its production and distribution? The workings of information, as a unit or energy as the driving force behind a new age of culture, remains a mystery. Information appears to be playing a role similar to that of agriculture in the 16th century or to that of steam in the series of transformations labeled as the Industrial Revolution.

Transborder Data Flows and the Information Regime

The rate and volume of data exchanges, the production and sale of the necessary technologies, the rise of a new class of skilled workers--all make it necessary to refer to an information economy. This means three things; first, there is a new locus of wealth, second, relations between the production and distribution functions are being reorganized, and third, rules for determining who gets what in society are altering according to the dictates of the first two conditions.

Information as a resource cannot be separated from its accompanying technologies; one reinforces the impacts of the other. Technological advances are not new but the centralized role of information may be unique. That role, however, would be impossible to maintain without its instruments; the resource, in turn brings form and substance to these instruments.

Together, these separate entities form a dynamic movement. Technological advances in the gathering, processing, and exchange of information have moved a radically different resource to the center of societal relations. The nature of information is conditioning a new set of interactions. The characteristics of the information environment resulting from these forces has been described by McHale:

- Exponential increase in the volume of data flows;
- Time and distance no longer constrain communications;
- Decrease in the "time cushion" between socio-technical change, their impacts and consequences;
- Increase in dependence upon information and communications services;
- Global shrinkage;
- Growth of complexly linked systems subtending basic societal services;
- Increased interdependence of previously autonomous institutions and services due to feedback required for common information;
- Abrupt changes in perceptions of socio-physical environment; and
- Radical conceptual changes induced by increased information and communication.

The Emerging Information Regime

These conditions increase the variety and range of challenges to which nations must respond. New types of interactions, sources of conflict, vulnerabilities and so forth are all part of the changes created by the information phenomena. Nations and other actors may no longer be restrained by the behavioral norms of their history.

New constraints, however, have not yet developed and old conditions have not completely disappeared. Old and new exist side by side without either having the necessary strength to determine new rules. The result is confusion, uncertainty and, often, threatening. New actors on the scene challenge the older ones; institutions created by the new technologies threaten established entities who have not yet developed effective tools with which to meet changes in their environment.

The greater the range and variety of options, the greater the strain on resources. If existing institutions are to maintain their viability, they must find some way of reducing these options, or, at least, managing them.

Nations have countered the transborder data flow movement with barriers to exchange. These constraints are one of the few means available for protecting their interests until such time as new capabilities can be developed. As self-defense mechanisms, they show:

- Those actions and situations which they view as active or potential threats to their sovereignty;
- Those sectors whose protection they believe to be most important;
- The efficacy of state bureaucracies in identifying such threats, formulating policy and implementing them;
- The changing government/business relationship as they seek to counter the emerging threats; and
- The degrees of inter-governmental cooperation and conflict in adapting to newly created conditions.

The channels used to regulate these concerns are the first stage in the evolution of an international information regime. As such, they have a feedback effect upon the information revolution. Barriers to data and technology transfers are attempts to slow the rate of change to manageable proportions; they are ways of controlling the varieties of transfers created by the transformation process. They reduce the limits of opportunity in order to maintain a degree of order necessary for stability.

The information regime is barely perceptible in the international system at present, but it is there. The regime is illustrated by those formal and informal procedures used by nations to regulate the impacts of transborder data flows. They include privacy regulations specifically relating to communication technologies, tariff barriers restricting data exchanges, legislation governing

technology transfers, and a host of other measures at the national and international levels.

This important emerging regime suggests that there is a new set of conditions to which nations are responding, and that these conditions determine the options available to nations in selecting their response mechanisms.

The choice of barriers for individual states rests, in part, with perceptions about the changing international environment. There are any number of views about the role of information and its accompanying technologies in the development process. Developed countries tend to see information as one sector (an important one) in an overall national economy. It needs to be fostered as an agent of continued growth. At the same time, the information sector must be protected in order for the state to function competitively in the marketplace.

An alternative view holds more hope for less developed countries. Information is not only a sector of an economy. It is first and foremost a mechanism of control. The direction of change can be determined by increasing (or decreasing) transborder data flows. A state wishing to improve its bargaining position vis-a-vis other states must encourage ties to information networks and promote technological exchanges.

The implications of the two policies are quite different. The first is protectionist; barriers are ways of maintaining dominance in the international economy. The second, also nationalistic in approach, maintains that constraints can be used to maneuver a nation into a more effective global position; after all, the nature of information as a central resource and the capabilities of the new technological instruments do have radical impact. The value of information increases with use; it is non-proprietary; the use of computers and satellites removes the importance of location and distance; it is conceivable that traditional centers of commerce and finance can be passed by or reduced in importance by data traffic and new centers developed. New economic conditions may trigger movements from semi-periphery status to the core (and vice-versa).

Perceptions about the role of information, about kinds of transformation occurring, are not the only factors in exploiting the conditions of the information revolution. Success also depends on the skill with which a country can marshal its resources. It must have a strong base (not necessarily a traditionally important one) from which to meet changes in the technical environment. The following would seem to be important in this context:

- The capacity for technological expansion (including per capita level of income, etc.);
- A mutually reinforcing state/business relationship for maintaining a centralized monopoly of information;
- A state of telecommunications bureaucracy capable of intelligent change;

The existence of specific development objectives against which success or failure can be measured at reasonable, short term intervals.

At first glance, they seem to reinforce the dominance of the developed countries; those better organized societies, with stronger resource bases, should be able to make the transition to the information economy with a minimum of confusion. Some will, but others, however, may not be able to dislodge or alter traditional industrial economic and social structures. Their desire to match the variety of change will be conditioned by their stake in existing traditions and power states. In attempting to maintain them without change, they could, in fact, stagnate.

Strategies, then, are conscious attempts by nations to use the changes in the international system to improve their position vis-a-vis other nations. These strategies reflect perceptions about the information environment, and the skill with which they use their resources to meet those challenges. While opportunities to develop and implement information policies are extended by the nature of the information technologies, limitations are imposed by an evolving information regime (the specific mechanisms of these strategies themselves).

Strategies are a "first step" in response to certain, perceived conditions. States are influenced in their information decisions by their history--where they have come from--and their present, where they are now.

Information Strategies--Some Examples

Specifics need to be discussed in order to determine the kinds of information strategies likely to emerge and be successful. Before turning to several examples, the points made so far will be briefly summarized:

1. The international system is in a state of transition that is changing international relations.
2. This movement is given form and substance by the relationship between its two components: the force and speed of the computer-communications technologies; and the unique nature of information as a central organizing unit of energy.
3. The volume and kind of transborder data flows are a visible manifestation of the crisis of authority facing elite groups as a result of the information revolution. They have increased the range or occurrences or challenges to which nations must react.
4. This variety increases the drain on resources and capabilities. Nations are competing for response mechanisms which will ensure their survival. They have turned, for the most part, to data and technology barriers.
5. Barriers are the first phase in the development of an international informa-

tion regime. They are the formal and informal practices guiding nations in their information exchanges. They are, in effect, limitations on the rate of change.

6. The information revolution and its response, the information regime, are responsible for new conditions in the international system. They increase the likelihood of change through different sources of wealth, changing rules of operation, and new societal relations. Less developed countries are confronted by unprecedented opportunities to improve their positions.
7. Success in this endeavor depends on two factors:
 - (1) perceptions about the transformation occurring;
 - (2) the ability to marshal resources.In short, information strategies are the key for capturing the benefits of the information revolution.

With this in mind, several examples will be examined. The object is to assess how these nations' use of information strategies has led them to what can best be described as their initial strategic position within the information regime.

Emerging Information Strategies ...In the United States

We begin with the United States. Clearly, the U.S. has the most to gain from maintaining the status quo and the most to lose should there be a significant restructuring of the rules of the game.

Information is viewed as a necessary resource for technological and economic development; it is required for the efficient management of enterprises and personal affairs. It has value and is freely and widely available for purchase. Some information is more valuable than other information and the price reflects that difference. It is commodity for trade and should have access to all markets, indeed, because of its unusual importance it ought not to be tariffed, rather its export and its purchase should be welcomed and encouraged. In any case, it is difficult to define and determine tariffs for information and information services since so much of it is transferred or exchanged through the activities of consultants and via the activities of the multi-national organizations. It is believed that the transfer of information through these multi-national organizations will be to the long term benefit of the U.S. trading partners.

The U.S. views the emergence of network marketplaces and network production facilities throughout the world with favor, seeing this as a desirable outcome of the economic, political, social and technological developments creating the information economy.

Telecommunications and computing have developed along separate paths in the United

States; communications has been a natural monopoly and has been regulated with AT&T being, by far, the major actor on the scene. While not a monolithic entity as a PT&T, AT&T and its companion common carriers have essentially shaped communications policy for the United States.

Computing, on the other hand, has been a highly competitive industry shaped by the marketplace, despite the dominance of IBM.

Except for the First Amendment, the copyright and patent laws, there is no national information policy in the U.S. Indeed, there has been resistance to its study because of these historic practices.

Realization that the convergence of the computing and communicating technologies will have profound market implications began to emerge in the early 60s. Under pressure from IBM and the major users of high speed computing, and seeking to end the dominance of AT&T over at least a portion of the communications market, the FCC allowed competitors to enter the long line telephone markets. At the same time additional challenges to the AT&T monopoly emerged in the form of the Carterfone decision which opened the door to the use of data/computer terminals other than those supplied by AT&T.

Projections of demand for services showed that in the not too distant future, revenues from computing and information processing would far outdistance revenues from transmission alone. Indeed, it could be shown that for every dollar spent for transmission as much as \$4 would be spent for terminals, software, and information processing.

As a result of these activities and findings, communications policy in the United States has been under review; the Communications Act of 1934, long a noble mainstay for this nation and often copied elsewhere, was believed to be inadequate for the future. Congress has been debating a new Communications Act for almost 5 years and appears quite close to adopting a version that will allow the monopoly carrier--AT&T--via a rearrangement of its corporate structure to enter the rapidly growing information markets. It is hoped that sufficient controls will be exerted by both market forces and selective government regulations to achieve a very dynamic and competitive information market in the United States.

Telecommunications in the U.S. is moving towards an integrated digital services network through the gradual conversion of the existing network to digital transmission. At the present time, digital services are provided on the existing voice network via data-under-voice design. Consequently, there is no separation between analog voice services and digital data communications services on the national network except where requested and provided on private lines. The recently launched Satellite Business Systems services are essentially private line services.

International information services, (trans-border data flows) enter freely and are transmitted along the national network if they are not directed to private networks between multinationals. In any case, in the United States the international record carriers provide these services at costs determined in part by market forces in the U.S. and through negotiation with foreign PT&Ts.

The United States, then, is opting for a strategy of free flow of information. In this sense, it is preparing for a world-wide integrated digital services network where it will be impossible to segregate information products from voice products, if, indeed, it has ever been possible to do so. After all, television programs, news, books, magazines, and letters are information as is high speed data for end use or for interim processing.

...In Brazil

On the 10th of May, 1979, "in a small room of the Hotel PLM Saint-Jacques in Paris, there occurred what can only be called an historic event." In this way the Brazilians announced that they were entering into a major program leading to the creation of a most modern telecommunications system for Brazil. They went on to state that..."this is the first time in the history of telecommunications, but also in the history of science in general, that a country undergoing industrialization decides to enter a project of research and development of such proportion all alone."

Brazil chose this route because they believe that:

- the traditional frameworks of international cooperation between countries of different levels of technological development are "doomed to failure."
- the advent of electronic technologies and the very need for the highly industrialized countries to thoroughly revise their structure to face up to the new development, "for the first time provide the industrializing countries with an opportunity to be competitive, if not on an equal footing, at least not in a totally unstable situation."

Brazilian industrialization policy calls for the absorption of technology, not merely its transfer. "Brazilian businesses must progressively incorporate not simply transfer all the new technology...It is not here a question of re-inventing the wheel, but of taking steps towards making improvements to that wheel at the same time as those made by the already industrialized countries.

Brazil recognizes the importance of the information industries to its industrialization. Telecommunications technologies and services, information products and services must be as much as possible in Brazilian hands. Wherever possible, systems and equipments will be manufactured and/or assembled in Brazil and no foreign

company will operate in Brazil unless it is at least 40% Brazilian owned.

To support this desired goal for the information industries, Brazil has inaugurated a plan for substantial growth in the number of telephones; indeed, between 1965 and 1977 there was a 178.5% increase in the number of instruments available. While this represents, in numbers, merely a growth from 1.4 million instruments to 4 million instruments, it is, nevertheless quite significant. The very fact that the installed base is low also enables the Brazilians to plan now to install a fully integrated digital services network. The core of this network is their rather substantial Telex system which serves many of the industrial and business firms in the nation. Conceivably, this clientele will also be the initial customers for data transmission services and will underwrite the further development of the digital services network.

It is this rapidly growing Telex cum digital network (between 1972 and 1978 Telex messages grew by 160%) which the Brazilians see as their link to the international information markets and which enables them to establish a gateway for the reception and transmission of information products (between 1972 and 1978 international calls increased by over 500%). This combination of philosophy, politics and technology has enabled the Brazilians to develop a highly protectionist strategy for the information regime.

Brazilian information strategy is based upon the desire to protect the Brazilian labor market and the operation of national firms and organizations. All data links must be approved by the Brazilian government and must be renewed every three years. It is, of course, expected that as Brazil's data processing capabilities increase, and as their software capabilities improve, the government will more frequently deny requests for international data links.

Brazil has also established import restrictions on data communications equipment and software and limits the number of visas for foreign salesmen to enter the country to market their wares. Further, there is a 4% duty and an 8% value added tax on all microfilm documents and publications imported. It is very likely that this taxing policy will be extended to software and other information products.

Brazil has established restrictive policies with respect to the right of foreign firms to establish or develop local information industries. Partial local ownership (at least 40%) is required for firms manufacturing telecommunications equipment and for data processing firms.

In contrast to the U.S. strategy for the information regime, Brazil has created a very restrictive one. While in the short run it may place the Brazilian information industries, as well as other industries requiring their services, at a disadvantage both in terms of

price and service quality, it is believed that in the long run, it will enable Brazil to enter the information era in a manner that is competitive with the more advanced nations.

...and in France

Nora and Minc make it quite clear that France sees the development of their information industries (Telematique) as the key to their survival in the information era and, further, the development of foreign trade.¹¹ In that remarkable policy document, Nora and Minc argue that the productivity that will accompany the information economy will bring high levels of unemployment and that only substantial increases in exports will reverse this trend.

The French see information products and services as well as the equipment and systems required to produce them of prime importance to their economic growth. Information goods have economic value; a nation that cannot provide the information products necessary for its citizens and industries has lost a good measure of its independence and control over its sovereignty.

The French PT&T is the original on which many of the other European nations have modeled their PT&Ts. It maintains a monopoly on the transmission of messages and for programming the broadcast facilities of the nations. It also seeks to maintain control over the production of industrial equipment necessary for the French telecommunication networks and to assist in the research and development of these equipments. The PT&T also wishes to maintain tight control over the new network developments including the TRANSPAC system (the French data communication network portion of Euronet), over the development of the domestic satellite for business use (the French attempt to counteract the U.S. SBS) and over the development of the Direct Broadcast Satellite. It argues that only in this way can France effectively defend itself against foreign competition.

The PT&T's control over value added information services has come under attack from private competitive firms seeking to enter a growing market. Their industry organization, the Societes de services et conseil en informatique (SSCI) has publically expressed fears that the PT&T will "exceed their limited monopoly" by entering this area of the market.

In 1979, Daniel Chauche, a well regarded consultant to the Ministry, argued that ways will have to be found for mutual cooperation between the PT&T and the members of SSCI in the value added services market.¹² But the recent French elections place this possibility in question. It remains to be seen, however, just what happens after this period of ideological debate is over and the French begin to examine the realities of the international information regime.

Telephone expansion in France is proceeding at a very rapid rate, exceeding 20% per year. (It is said that of every 10 telephones installed

throughout the world today, 2 are in France!) The expansion of the telephone to the provinces will be digital. Interconnection with the major cities, Paris, Marseilles, Bordeaux, etc. will follow as they, in turn, convert to an integrated digital services network. In the meantime, A/D and D/A converters will be used where necessary.

Cooperation with the European Common market, at least for the flow of information appears to work quite well, with the establishment of data gateways in Lyon, for Italy, in Strassbourg for Germany, and in Lille for communication with Belgium and Holland. At the present time there are no gateways for the U.S. and for Great Britain although the French have hinted strongly at the possible need for software assistance for U.S. products entering French businesses. And it appears likely that France will move towards a more protectionist attitude in the areas of telecommunications equipment and services and information products and services.

How quickly this will occur and in just what form depends very much on how the French resolve their internal debate concerning competition in the information industries. In many ways the French dilemma is quite similar to that in the United States, with the PT&T in the role of AT&T. The established entities wish to maintain their powerful positions in the face of the value added industry upstarts. If the conclusion is to allow more competition, a strategy for the information regime might evolve to be rather more free and open than one might expect and while the flows will not be entirely market-based, it will, nevertheless allow for a reasonable degree of international competition. But if the PT&T is allowed to enter the value added markets and is given the authority to increase its power, we can expect a more protectionist and restrictive strategy.

Conclusions

This report of work-in-progress shows that strategies for the information regime are in the very early stages of evolution. The nature of the regime itself is yet to be defined and as this emerges we can expect varieties of strategies to deal with it. It is already clear, however, that these strategies will respond to two major influences:

- 1) Perceptions of the importance of information and information industries to national development and industrialization, and
- 2) The structure and technologies of the information industries as they evolve in the emerging nations.

For years the concept of development communications has been discussed and researched. It was only recently that it became apparent that in nations where the vast majority of their budget is devoted to development, communications for rural development was in fact communications for the entire nation, rural, urban, industrial

and public, and any attempt to define a solely rural development role for communications was artificial. Furthermore, the rapid growth of the satellite with its ability to cross international boundaries and of the small media to "infiltrate" all levels of society made national control of information difficult if not impossible. In many nations, the expenditures already made for information media--radios, television sets, cassette recorders, both video and audio--have far exceeded what the national planners would have expected. There are few industrializing nations in the world today where a substantial information sector does not already exist. Like it or not, many nations are well on the way to being participants in the information era. Their desire is to become active rather than passive participants in that second industrial revolution.

The development of national information industries raises serious questions about the notion of appropriate technology. Indeed, one ought to reexamine the idea of appropriate technology and consider the following highly in appropriate ideas that have been ascribed to "appropriate technology:"

- have low capital costs
- use local materials
- be small scale
- be locally produced
- does not have patent, royalty or require consultants.

It is clear that the driving technologies for the information era--the satellite and the semiconductor chip--do not, at all, meet these definitions of an appropriate technology. Yet they are proving to be of utmost importance to many newly industrialized countries and are being sought after by all lesser developed nations.

However, there are serious caveats that must be raised. The productivity that these nations seek and which can be provided by these technologies may, indeed, lead to high levels of unemployment. The importation of these technologies could lead to strengthening undesirable dependency links. Further, their utilization in the developing nations will most certainly result in increasing economic, political and social disparities among the peoples in the developing nations.

Information strategies for the international information regime are designed to mitigate these negative impacts. They are absolutely necessary for the development of a more balanced world economic climate and for reducing the gulf between the industrialized and the yet-to-be industrialized nations of the world.

Can the Information Revolution reverse the trends of unequal development begun during the sixteenth century with the advent of capitalism and solidified by the Industrial Revolution? This will depend on how well the emerging strategies for the information regime developed by nations can balance the appropriate and inappropriate impacts of the information

technologies.

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THE PACIFIC, TELECOMMUNICATIONS AND SOCIO-ECONOMIC DEVELOPMENT

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Abstract

This paper examines the economic and communications development of the Pacific Ocean Region, particularly the ASEAN countries, as well as the island countries of Oceania. The relationships between economic development and implementation of satellite communications are analyzed. Also examined is the need for integration and planning for communications development programs, particularly in terms of the relationship between satellite communications and terrestrial systems, as well as between programming and human resources on one hand, and telecommunications and broadcasting facilities on the other. Significant achievements in both communications development and economic development for the ASEAN countries, as well as the island countries of Oceania, are projected for the next 20 years, with communications satellites playing a vital role in these achievements.

Everyone has his own definition of the Pacific. Therefore, I will provide yet another, at least for the purpose of this paper. The Pacific, by my reckoning, is a collection of more than 50 countries, territories and independent possessions representing almost half of the world's population. For the reference of the reader, these are listed in Attachment 1. By general groupings, there are 13 countries along the eastern shoreline of the Pacific, ranging from Canada in the north to Chile in the south. Along the western coastline of the Pacific, there are some 19 countries, ranging from the Soviet Union in the north to Australia and New Zealand in the south. Sprinkled throughout the Pacific Ocean Region, there are 21 island countries, territories and independent possessions. Finally, there is the Antarctic in the most remote southern region.

The diversity of these 54 countries, territories and entities is enormous. In terms of population, they range from the world's most heavily populated, the People's Republic of China, with some 1,000 million inhabitants, to Tokelau, with a population of some 1,600 people. In terms of geographic size, the range is likewise enormous. The Soviet Union, with an area of 8,650,000 square miles, dwarfs Nauru, with an area of 8 square miles. Indeed, almost every extreme is found throughout this region -- in terms of levels of economic development, density of population, sophistication of telecommunications and broad-

casting capabilities, degree of literacy and education, etc.

It is because of this diversity and these extremes that generalizations about the Pacific as a region are difficult to make. Despite the great differences, however, there are certain common themes and issues that are prevalent throughout the region. These are as follows: (a) The Preeminent Importance of Transportation and Telecommunications: In light of the great geographic size of many Pacific region countries, the difficulties of physical access presented by geography, terrain, tropical vegetation and, finally, the great physical isolation of many island countries and territories, the Pacific has very special needs in the areas of transportation and telecommunications. Proximities in the Pacific are often measured in the thousands of kilometers, rather than in hundreds or tens of kilometers. (b) Special Requirements Resulting from the Ethnic, Cultural and Linguistic Diversity of the Region: The languages, dialects and cultures of the Pacific number in the thousands. Papua New Guinea alone has over 700 distinct tribal dialects. Regional planners and instructors (such as those who work for the University of the South Pacific and the South Pacific Bureau of Economic Cooperation) know of the difficulties that must be overcome. The great diversity of language represents a significant communications barrier to shared learning and cultural sharing throughout the region.

(c) Special Problems of National Integration: Most countries of the Pacific, including the giants like the U.S.S.R., China, U.S.A. and Japan, as well as many smaller countries, have island territories or possessions that are isolated from mainstream national programs and activities. Literally tens of thousands of these islands exist. Indonesia alone consists of 13,000 islands and the Philippines some 7,000. This remoteness makes it difficult to provide effective governmental services to remote island territories. (d) Spheres of influence and Trade Zones: The Pacific is a complex network of special spheres of influence, historical relationships and trade zones. It is in many ways a collection of parts, rather than a totality. The "Pacific" seems to be in a state of flux and transition that can be traced to several factors: (i) the increasing availability of modern telecommunications; (ii) the move toward national independence of many Pacific island countries; (iii) the growing success of ASEAN economic integration; (iv) the willingness of Central and South American countries to look at new trade relationships in the Pacific; (v) the emergence of the People's Republic of China as an important Pacific trading country; and (vi) the special historical ties and responsibilities to the region represented by key European countries, especially France, the Federal Republic of Germany, the Netherlands, and the United Kingdom.

Despite the strength of historical ties to Europe and continuing patterns of economic aid, the evolving international and regional relationships of the Pacific seem to be more related to trade, economic development goals and physical proximity than to past cultural and historical ties.

With this overview of the Pacific Ocean Region, I would like to now fully develop and explore the issue at hand -- namely, what is happening to telecommunications in the Pacific Region and what, if any, are the practical results of these trends. For this purpose, I would like to look briefly at: (a) the ASEAN countries; and (b) the island countries of Oceania. Obviously, it would be interesting to look at much more than these two regional groupings of countries, but time does not permit. Even so, some important general conclusions emerge from this investigation that apply to other parts of the region and indeed to other parts of the world.

The ASEAN Countries

If the ASEAN nations were a single country, they indeed would represent a major force with which to contend. The population of this hypothetical ASEAN country would be 260 million and, as such, would be the

world's fourth largest. Its geographic size, of almost 1.2 million square miles, would be the eighth largest, while its gross domestic product of over \$125 billion would place it tenth in the worldwide lineup.

Virtually all forms of communications for the ASEAN countries have expanded over the last decade, typically with growth rates in telephones, television receivers, etc., expanding in real terms of from 5 percent to 20 percent per annum. Indonesia, in particular, has embarked upon an ambitious domestic communications satellite project called PALAPA. This project was conceived by President Suharto in 1972. On 15 February 1975 Hughes Aircraft Company was selected as the satellite supplier, and ITT and Ford were selected as the earth station suppliers. This initial project was designed to promote both social services and industrial development. Twenty-six of the forty earth stations in this network were assigned to each of Indonesia's provinces, while the remaining terminals were assigned to industrial or industrializing areas. The 26 provincial earth stations now provide a wide range of services, including telephone, telex, radio and television. Seven hours of television per weekday, with longer broadcasts on weekends, is provided by TVRI (the Indonesian television network). The weekday broadcast consists of 1 hour 20 minutes of U.S. action or cartoon programming; 1.5 to 2.5 hours of news; and the remainder is cultural/music/dance and language programs.

The Indonesia Ministry of Education and Culture is planning to greatly expand its social services offerings via PALAPA A and the follow-on PALAPA B satellites that will start operations in 1983.

The key to these services is the Kecamatan Education Resource Center (KERC), which is already producing programs on how to increase food production; continuing education for school dropouts; health education; nutrition; general education and orientation programs for the population; and upgrading instructional programs for teachers. Their first objective is to produce three hours of programming a day. KERC services currently stress radio programming, even though television capabilities are being expanded under a training program carried out in cooperation with Syracuse University in the U.S. The satellite program is actually just a part of the overall development program that involves village resource centers, radio cassettes and players, text materials, installation of free TV receivers, construction of 300 new telephone switching exchange centers for 300,000 new telephones,

etc. A UNDP project, involving the University of Hawaii's Professor Norman Abramson, is currently planning to establish a random-access national data network modeled after the ALOHA-NET. This network will provide data services to the huge Indonesian Rice Commodity Exchange, the banks, the Government and others.

Despite the achievements produced by the Indonesian satellite project to date, the PALAPA program has been extremely costly. The total capitalized space and ground segment costs are now in excess of \$200 million, while annual operating costs are in the millions of dollars. Most other countries with developing economies have

thus opted for much lower cost transponder leasing arrangements for providing expanded domestic satellite communications services.^{1/}

This leads us to a discussion of INTELSAT and the ASEAN countries. INTELSAT has also played an important role in the communications development of the ASEAN countries. All five countries joined the original INTELSAT Consortium in the 1960's and then became Parties to the permanent arrangements when the INTELSAT Organization was created in 1973. The ASEAN countries have a total of ten international earth stations, which are as follows:

ASEAN COUNTRIES -- INTELSAT EARTH STATIONS

<u>Country and Earth Station</u>		<u>Operating Region</u>
Indonesia	Djaijiluhur 1 & 2	Pacific, Indian
Malaysia	Kuantan, Melaka	Pacific, Indian
Philippines	Pinguay 1 & 2	Pacific, Indian
Singapore	Sentosa 1 & 2	Pacific, Indian
Thailand	Si Racha 1 & 2	Pacific, Indian

As of year-end 1981, the ASEAN group had approximately 1700 international voice circuits in operation over the INTELSAT System, representing over 6 percent of INTELSAT's total traffic. ASEAN international satellite traffic is projected to grow to over 11,000 international voice circuits by 1995, or the equivalent of the current use by the United States of the INTELSAT System. If normal relationships between telecommunications development and economic development hold, this suggests that the ASEAN countries will represent a \$1 to \$2 trillion economy by 1995.

Long-term lease of satellite capacity on INTELSAT satellites for domestic service has been an important service option to the ASEAN countries. Malaysia leased a full global beam transponder to provide domestic telephone and television service to remote provinces from 1 August 1975 to 31 July 1980, at the rate of \$1 million per annum. Malaysia is now considering

the possibility of a new full global beam transponder lease from late 1982 through 1987. This service would be provided at INTELSAT's current preemptible service rate of \$800,000 per annum. As of November 1981, Thailand initiated a domestic system using one-fourth of a global beam transponder INTELSAT lease to provide service to a network of 16 earth stations. Initially this service will be provided at an annual rate of \$200,000. By mid-year 1982, however, this will convert to a three-quarters of a hemispheric beam transponder lease^{2/}, at an annual cost of \$720,000. This lease will be for a five-year period, from 1982 to 1987.

Finally, submarine cables have played a role in ASEAN countries' telecommunications planning. Three major submarine cable systems, with major ASEAN participation, have been constructed in the last five years, at an expense in excess of \$200 million.

MAJOR NEW ASEAN CABLE SYSTEMS

<u>Date of Operations</u>	<u>Cable Name</u>	<u>Countries Connected</u>	<u>Distance</u>	<u>Capacity 3KHZ Telephone Circuits</u>
1977	OLUHO	Japan (Okinawa)/Philippines/Hong Kong	1400 miles	1,380
1979	PHILSIN	Philippines/Singapore	1500 miles	1,380
1981	India-Malaysia	India/Malaysia	1900 miles	500

^{1/} In particular, it is interesting to note that over 20 countries have leased capacity for domestic services. Over 24 transponders have been leased and well over 100 antennas have been deployed, all at an annual cost of one-half that represented by the PALAPA System.

^{2/} Hemispheric beam transponders provide about 3dB higher domestic power than a global beam transponder.

Thus, it can be seen that the ASEAN countries have placed great stress on the development of high-quality domestic and international communications over the last decade and have ambitious plans for the future.

In light of the above, what can be said about future trends toward economic and social development of the ASEAN countries? First, the economic growth of the ASEAN countries has been sustained and rapid since the formation of this Association in 1967. This success has prompted Sri Lanka and Papua New Guinea to seek entry into the ASEAN group of countries.

Because good communication is so central to regional integration, to international trade, to manufacturing and to social, health and educational services, it can be anticipated that economic growth and communications will proceed rapidly for the ASEAN countries in the next decade as well. The INTELSAT System, the PALAPA Satellite System, and the ASEAN Submarine Cable Network (that now connects Japan, the ASEAN countries and India) will all play a vital role for the continued growth and development of the ASEAN region in the 1980's. It can further be anticipated that the new Asia/Pacific Telecommunity can help play an effective and important role in stimulating the necessary communications development to support the roles of the ASEAN countries.

Looking to the year 2000, several important projections can be made for the ASEAN countries. These are that, as a group, they will become significantly more prosperous, manufacturing will have become a more economically significant factor than agriculture in the respective national economies, that geographic isolation of rural and remote island populations will be largely eliminated and that satellite communications in particular will be playing an important role in the achievement of these goals. Given the vast distances to be covered and the remote island populations to be reached, it is doubtful that terrestrial systems alone can provide effective answers.

On the other hand, terrestrial systems, such as VHF radio systems, will likely continue to be the most cost-effective way to reach the most remote areas for some time

to come. Therefore, heavy investment in space and terrestrial facilities for telecommunications and broadcasting services can be anticipated in the next decade. The bulk of expenses, however, will likely fall in areas like training, salaries for resource personnel and field extension agents, programming and other elements sometimes described as "software." As telecommunications hardware costs and associated equipment show a continuing trend towards reduced "per-unit costs," and as labor costs continue to mount, this investment profile will be increasingly true. We at INTELSAT believe that our new satellite facilities for the 1980's will not only be more cost-effective, but will allow investment in new telecommunications development programs that will reach an even larger share of the public than has previously been isolated from reliable communications.

The Island Countries and Territories of Oceania 3/

Let's now turn from the ASEAN countries to Oceania. This region well deserves its name, in that the predominant feature within this group of countries is the Pacific Ocean. If one exempts Australia and New Zealand from this group of over 20 countries and territories, one is left with a group of island countries and territories representing some 1,300 islands or island groupings, having a population of about 5 million people, over 3 million of which live in Papua New Guinea. The remaining 2 million people are sparsely spread over a vast region of the Pacific many millions of square miles in size.

Despite the great challenges presented by remote locations, there have been some important recent developments with regard to telecommunications services for the island countries of Oceania. In particular, there are three closely interrelated factors that are stimulating important progress in the South Pacific in this regard: (a) new institutional mechanisms for the delivery of teleservices; 4/ (b) the availability of Standard B INTELSAT earth stations throughout an ever increasing portion of the South Pacific Region; and (c) new terminal devices and new software.

3/ Excluding Australia and New Zealand.

4/ Many institutions, particularly those in Fiji and Hawaii, such as the South Pacific Bureau for Economic Cooperation (SPEC), the ITU's Regional Office, the World Health Organization's Regional Office, the University of Hawaii, and the East-West Center, among others, have also played a positive and supporting role in encouraging the delivery of teleservice in the South Pacific.

1. Tele-Educational and Extension Services -- New Institutional Mechanisms

Educational and extension services by satellite, in such areas as health, agriculture, rural development and natural resources, have been impressive. In particular, the University of the South Pacific's satellite network (USP), the PEACESAT project, and the U.S. Department of the Interior Project (DISP) have enjoyed considerable success in providing cost-effective teleservices to remote regions at low cost.^{5/} Although all three of these projects are experimental programs based on donated satellite time, they have indeed shown that such programs are effective tools of development and education and that television is not essential to achieving successful programs. The challenges of the next few years will be to convert such experimental programs into operational, ongoing projects. When the ATS-1 experimental satellite fails, it is likely that currently provided educational and outreach programs will be transferred to the INTELSAT network. New INTELSAT tariffs for multipoint conferring are being explored to ease this transition.

2. Rapid Implementation of Satellite Communications

The deployment of INTELSAT earth stations (typically Standard B) throughout the island countries of Oceania has been extremely rapid in the last few years. Today, there are earth stations in American Samoa, Cook Islands, Fiji, French Polynesia, Kiribati (Christmas Island), Nauru, New Caledonia, Saipan, Solomon Islands, Tonga, Vanuatu (New Hebrides) and Western Samoa. In the near future, there will be additional Standard B earth stations in Bairiki, Kiribati, Belau (Palau) and Papua New Guinea. Although the earth stations in Fiji and New Caledonia are the large, 30-meter Standard A earth stations, all of the remaining earth stations are of the ten to eleven-meter Standard B class. These stations represent a significantly lower capital investment and, in light of the low traffic requirements of most island countries, represent a more cost-effective approach to telecommunications. The INTELSAT earth stations now in operation in the South Pacific, as well as those planned for the near future, are significant first steps towards removing the element of physical isolation that has been so prevalent in these regions for so many years.

3. Terminal Equipment and Software

New developments in terminal hardware, new methods of providing teleservices, new software, and new training techniques, are providing means to offer cost-effective services to rural and remote areas. New opportunities in this area include: slow-scan television; electronic blackboard; computer polling of recorded telephone messages; telephone circuit bridges to allow multidestination access on a single voice circuit; word processing networks to allow cost-effective written message interchange;^{6/} group audio conference techniques; educational radio broadcasts; use of satellite and terrestrial links in tandem; and distribution of audiocassettes to remote villages. Use of such techniques and others of a similar vein can offer a wide range of new opportunities for providing educational and social services to the South Pacific.

The potential of satellite teleservices for the South Pacific is clear. When Tonga implemented a Standard B earth station, it was found in a matter of months that the prices of imports could be reduced and the price of exports could be increased through effective use of international telecommunications. It has been shown, in Dr. Hudson's study of the University of the South Pacific's Extension Services, that the cost to a student to take a 15-week tutorial via satellite averaged just over \$100, while the cost per student at the Fiji main campus averaged almost five times as much.

Certainly, satellite communications are not a panacea. An effective combination of satellites and terrestrial systems (including audio cassette distribution of certain materials) will most likely provide the best answer to the needs of the most thinly inhabited island countries in the South Pacific. Indeed, there perhaps has been a disservice caused by certain well-meaning studies of so-called higher powered, lower-cost satellite communications services that have prematurely predicted that rural communications services can be provided directly to every village at low cost and in the immediate future. Clearly, development of the 20/30 GHz frequencies, higher powered satellites and, ultimately, even space platforms, hold enormous potential for the future, but the promises of future technology must not be mistaken for today's realities. The INSAT

^{5/} See Selected Bibliography of articles describing these projects.

^{6/} Interconnected word processors can communicate information on a "per-word basis" up to 100 times more cost effectively than voice communications, although interactive response and spontaneity is lost in such methods of communicating.

and PALAPA satellite projects have both recognized that terrestrial systems to provide the last mile connections are crucial to the success of their programs.^{7/} Likewise, most of the domestic lease arrangements that INTELSAT now provides have all tended to provide interconnection of regional capitals. That is because the terrestrial networks, telephone switching centers and telephone sets are already available in those cities. Thus, direct telephone services to a significant percentage of entire national populations can be immediately implemented. The need to effectively integrate satellite technologies with existing and future terrestrial systems is an extremely important part of telecommunications planning.

The second caveat relates to the overall philosophic approach to development. Programs such as the University of the South Pacific's Extension Services and its "Pacific Outreach," have largely focused upon diffusion of developmental information to extension workers, professionals, paraprofessionals, and a variety of field agents who, once learning about new technology and scientific methods, seek to stimulate the diffusion of this knowledge among the general population. There has been, in recent years, considerable debate about development programs targeted to key "change agents." Alternative approaches have been tested in India, Kenya and elsewhere. These alternative projects have suggested that other approaches, more directed toward the mass level, can perhaps be even more successful in stimulating rapid development of technological innovations.

To accommodate a program of development that relies more on mass education, different types of satellite and terrestrial telecommunications networks may be necessary. Although these different types of networks would perhaps have little impact on the satellite technology or design, it could reshape the type of terminal equipment utilized, stimulate the use of different types of ground antennas, alter the type of training and software utilized, and revamp the mission of the fieldworker. Even in terms of satellite network design, new systems, based on random-burst mode access for more decentralized delivery systems, could find new applications in the delivery of social services. Likewise, satellite broadcast receive-only networks could perhaps be envisioned. Such networks might become interactive, with "return access" by telephone, telegraph, or even mail systems. It is perhaps one

of the major untested hypotheses of satellite-distributed teleservices as to whether approaches other than the traditional diffusion model is the most effective one. Certainly, there are scores of creative combinations of satellite and terrestrial communications systems yet to be tested; one dimensional models of development or of satellite communications must be avoided.

Despite the two caveats that I have just mentioned, it still seems that the potential of satellite communications as an instrument of socio-economic development, both within the South Pacific and the ASEAN countries, is enormous. Truly significant strides can be anticipated within the next decade. Certain trend lines will be of considerable interest to follow. These include whether or not new teleservices and other aspects of economic development programs rather naturally lead to greater concentration of remote populations around urban centers. Another important matter to monitor will be the impact on social development created by the political independence of newly emerging South Pacific island countries. Presumably, this trend toward political independence will impact upon trading patterns, rates of economic growth, balance of payments, and forms of social aid and development.

A third subject is that of regional leadership. In the South Pacific, Fiji now plays a key role. It is the central hub in the University of the South Pacific network. The location of the ITU, World Health Organization and SPEC in Suva, Fiji, has given some impetus toward the recognition of Fiji as a regional center for the island countries of the South Pacific. Yet, strong economic, social and cultural relationships with Australia, Canada, France, the Federal Republic of Germany, Japan, the Netherlands, New Zealand, the United Kingdom and the United States, create tendencies toward a far more complex series of bilateral and multilateral relationships. Indonesia, as the largest ASEAN country and with the most difficult development objectives to achieve, is sometimes seen as the key country of this region. Clearly, the patterns of regional leadership of the South Pacific, for the ASEAN countries and even the Pacific as a whole, are in a formative state, where any firm conclusions are likely to be premature.

^{7/} Studies conducted by India for INSAT, by the ITU, and by INTELSAT, all confirm that terrestrial systems like VHF radio are more cost-effective for two-way, very thin-route rural teleservices for distances from 200 to 400 kilometers, depending upon the demographics of the country concerned, based upon the premise that villages are spaced about 10 kilometers apart.

Conclusions

In conclusion, it can be noted that communications services via satellite seem to be critically important to the economic and social development of both the ASEAN countries, as well as to the island countries of the South Pacific. The need to provide cost-effective services to a large number of remote, isolated populations is one that cannot be ignored. INTELSAT, for its part, intends to respond to those needs in several ways. We intend to continue existing programs that are beneficial to communications development, such as: (i) Standard B SCPC earth stations for international services; (ii) low-cost transponder leases for domestic services; (iii) low-cost transponder leases for international video exchange; and (iv) technical assistance through the INTELSAT Assistance and Development Program (IADP). We also intend to pursue efforts to provide satellite services better optimized to development communications. Possible options in this regard include the following: (i) making available higher power satellite transponders; (ii) authorizing, for domestic satellite services, lower-cost, small antennas, with side lobe suppression characteristics and relaxed polarization standards that are better suited to serve remote locations; (iii) exploring with INTELSAT Signatories new service arrangements and terminal configurations to allow institutions like the University of the South Pacific to achieve multideestination access and cost-effective communications services.

In the final analysis, however, the fact must be recognized that satellite communications is far from a panacea. There is a need to plan satellite communications systems in conjunction with terrestrial systems. Further, programming, terminal equipment, training, software, extension workers, etc., will be the chief elements of cost in development programs -- not satellites. Indeed, satellites should be a decreasing percentage of the overall cost. Well-meaning studies that suggest that "rural satellite communications," with heavy new capital investments, can solve everyone's development problems, must be critically considered, particularly in terms of timeframe for implementation, as well as in terms of reasonable levels of economic investment. Given a careful and judicious approach, however, the potential of satellite communications is enormous. Ultimate success in communications development via satellites must be considered the outcome of a 20-year struggle -- not an overnight battle.

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"THE PACIFIC"COUNTRIES OF THE EASTERN PACIFIC OCEAN

<u>Country or Territory</u>	<u>Islands Associated with the Country or Territory</u>
1. Canada	Queen Charlotte Islands, Vancouver Island, Parry Island, Prince of Wales Island, etc.
2. Chile	Easter Island, etc.
3. Colombia	Malpelo Island
4. Costa Rica	Isla del Coco
5. Ecuador	Galapagos Islands
6. El Salvador	
7. Honduras	
8. Mexico	Cedros Island, Guadalupe Island, Revilla Gigedo Island
9. Nicaragua	
10. Panama	Isla del Rey and Isla de Coiba
11. Peru	
12. U.S.A.	Santa Cruz, Hawaiian Islands, Santa Rosa, St. Lawrence, Aleutian Islands, Kodiak Island, Nunivak Island, etc.)

COUNTRIES OF THE WESTERN PACIFIC OCEAN

<u>Country or Territory</u>	<u>Islands Associated with the Country or Territory</u>
1. Brunei	
2. Cambodia	
3. China, People's Rep. of	Hainan, Hartan Tao, Chusan, Tungshan, Hingwa Wan, etc.
4. Hong Kong	
5. Indonesia	5 major islands and 13,000 minor ones
6. Japan	4 major islands (Kyushi, Shikoku, Hokkaido and Honshu) plus hundreds of minor islands, including Ryuku Islands and Okinawa
7. Korea, PR of	
8. Korea, Rep of	Cheju Do, Ullung Do, etc.
9. Laos	
10. Macao	
11. Malaysia	

COUNTRIES OF THE WESTERN PACIFIC (Continued)

13. Philippines	2 major islands and 7,000 minor
14. Singapore	
15. Thailand	
16. U.S.S.R.	Kuril Islands, Sakhalin, Wrangel, Komandorskiye, New Siberian Island, Franz Josef Land, Zemlya, Severnaya, etc.
17. Vietnam	

TERRITORIES OF THE REMOTE SOUTH PACIFIC
AntarcticaOCEANIA

1. American Samoa	7 islands
2. Australia	Tasmania, King Island, Furneaux, Melville Island, Bathurst Group, Stewart Island
3. Belau, Rep. of*	200 Islands
4. Cook Islands	15 Islands
5. Federated States of Micronesia	278 Islands
6. Fiji	320 Islands
7. French Polynesia	130 Islands
8. Guam	
9. Kiribati, Rep. of	33 Islands
10. Marshall Islands*	34 Islands
11. Nauru	
12. New Caledonia	2 Islands, plus 3 groups of islets
13. New Zealand	Stewart Island
14. Niue	
15. Northern Marianas, Commonwealth of*	16 Islands
16. Papua New Guinea	New Britain, New Ireland & sev others
17. Solomon Islands	10 Islands
18. Tokelau	3 Islands
19. Tonga	150 Islands
20. Tuvalu	9 Islands
21. Vanuatu, Rep. of	80 Islands
22. Wallis and Futuna	3 Islands
23. Western Samoa (Samoa)	2 Major Islands

*Trust Territories of the Pacific Islands.

Pacific Telecommunications After ATS-1: Reflections on ATS-1's Fifteenth Birthday

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1. Abstract

This paper provides a brief overview of the role ATS-1 has played in Pacific communications, and outlines the issues that must be addressed in the coming year if the Pacific is to move to other satellites to meet its thin-route and teleconferencing needs.

2. BACKGROUND

A recent anniversary marked a significant milestone in Pacific telecommunications history. Fifteen years ago, in December 1966, NASA launched its first Applied Technology Satellite, known as ATS-1. For the past decade, ATS-1 has provided experimental communications around the Pacific, for sites ranging from Barrow in the Alaskan Arctic to Wellington, New Zealand, and to numerous locations throughout the islands of the south and west Pacific.

Fifteen is an ancient age for a satellite. Commercial satellites today are designed for a life span of seven years, but ATS-1 was originally built for technical experimentation, with a projected life of only two years. That it is still operating is a tribute to NASA engineering and perhaps to the power of positive thinking of experimenters in the Pacific who have come to believe in ATS-1 as an important tool in Pacific region development. After the original technical experiments had been completed, NASA made ATS-1 available to several organizations that wanted to test the potential of satellite communication for reaching remote and widely scattered populations.

3. ATS EXPERIMENTS IN THE PACIFIC

In the Pacific, ATS-1 has been used for distance teaching, program administration, consultation with experts, cultural exchanges, and emergency coordination. To many in the region, ATS-1 is better known as PEACESAT, which stands for Pan-Pacific Education and Communication Experiments by Satellite. The PEACESAT Consortium, headquartered at the University of Hawaii, was founded by Dr. John Bystrom, who saw ATS-1 as a unique tool for linking universities, government agencies, and development organizations around the Pacific. PEACESAT terminal locations include the University of Hawaii, the University of the South Pacific and its extension centres throughout the region, the University of Guam, Wellington Polytechnic in New Zealand, Sydney University in Australia, the Papua New Guinea Institute of Technology in Lae, and the South Pacific Commission in Noumea, New Caledonia. Many other locations around the Pacific participate in PEACESAT exchanges. (2)

There are two other ATS-1 user groups in the Pacific. The University of the South Pacific operates

USPNET to link its campuses and extension centres. USP's main campus is in Suva, Fiji; its College of Agriculture is at Alafua, Western Samoa. USP operates extension centres to enable students to take courses in their home countries. ATS-1 terminals are located at USP extension centres in the Cook Islands, Kiribati, Niue, the Solomon Islands, Tonga, Tuvalu, Vanuatu, and Western Samoa. USP's time on ATS-1 is used for three main purposes: tutorials for correspondence students, administrative support for Extension Studies, and outreach programs to make the resources and expertise of the university available to practitioners and planners throughout the region. International organizations including the World Health Organization (WHO), the International Labour Organization (ILO), and the South Pacific Commission (SPC) have used USPNET for experimental outreach programming. (1)

The other ATS-1 user group is the Department of the Interior Satellite Project (DISP), which operates terminals throughout the U.S. region of the Western Pacific. DISP sites include Saipan, Truk, Ponape, Majuro, Yap, Kosrae, and Palau (Belau). The DISP network has been used for medical consultation, experimental courses, and consultation between organizations in the region and experts in Washington, D.C.

4. THE ALASKAN EXPERIENCE

Another experimenter which shared ATS-1 satellite time with Pacific users for several years was the National Library of Medicine which began an experiment in 1971 to determine whether satellite communication could improve the quality of health care provided to native people in remote Alaskan villages. With technical support from the Geophysical Institute of the University of Alaska, simple earth stations were installed in villages in the Tanana region of central Alaska, where communication by HF radio had been notoriously unreliable. The doctor at the Public Health Service Hospital in Tanana was able to contact the village health aides via ATS-1 daily to consult on patient diagnosis and management and to arrange emergency evacuations. A satellite link was also provided to the Alaska Native Medical Center in Anchorage. A line from the earth stations to the village schools allowed village children and families to participate in educational programs and cultural

exchanges.

Five years ago, Alaska began the transition to operational satellite service for health communications and public telephone. Satellite stations purchased by the State and operated by ALASCOM using RCA SATCOM I are now located in more than 100 villages. The medical conferencing network operated by the Public Health Service using this system is modelled on the ATS-1 experimental network. (3)

5. CONFRONTING THE INEVITABLE

Users of ATS-1 in the Pacific are now confronted with the problems that faced Alaska in the mid 70's. ATS-1 cannot live forever; NASA has discovered that ATS-1 is burning up its station keeping fuel at an accelerated rate. To keep the satellite from drifting, NASA is studying the possibility of moving ATS-1 in 1982 to 162°E where it might keep functioning as much as two more years. This move could buy a little more time to plan near-term transitions and longer term strategies. However, the inevitable end of a most productive experiment is at last at hand.

Although no comprehensive evaluations of the ATS-1 experiments have been conducted in the Pacific, research on applications by the University of the South Pacific indicates significant benefits on administration of extension studies and potential impact in retention of students in correspondence courses. A meeting held via ATS-1 could cost as much as \$8000 in travel expenses and lost work time if the participants had to gather in Suva. Even using estimates of costs of a commercial telephone teleconference, telecommunications would cost one tenth the cost of face to face regional meetings. This is an important consideration for other regional and international agencies coordinating programs and services in the region. It also appears that well-run tutorials via satellite can improve completion rates of correspondence. (4) Such evidence will be important for ATS-1 experiments that must now determine how much they would be willing to pay for audio teleconferencing.

In some ways the situation in the Pacific is not as drastic as it would appear. In the South Pacific most countries now have reliable international communication via INTELSAT. Within three years only the smallest entities (for example Tuvalu, Tokelau and Niue) will still depend on HF radio. In the western Pacific, COMSAT plans to install INTELSAT stations in each major administrative district of the Federated States of Micronesia, the Marshall Islands, and Belau. A COMSAT station is already operating in Saipan.

6. PROBLEMS THAT REMAIN TO BE SOLVED

Several major problems remain to be solved. First, the smallest political entities must also have reliable communication--a sine qua non of participative in international affairs and running an independent government. But even with a satel-

lite station in each country or semi-autonomous region, the problem is far from solved. The Pacific contains thousands of scattered islands; most nations are composed of several inhabited islands. Many of these are small, and too distant to be linked reliably by terrestrial radio repeaters (the cost of undersea cable would be prohibitive in almost all cases). Some nations have large mountainous islands (e.g. the Solomons and Vanuatu) with populations that are virtually impossible to reach.

To use an Alaskan analogy, for most Pacific nations it is as if the only reliable communications were in Anchorage. The second problem, of reaching the villages--and in many cases, the towns--of the Pacific has yet to be addressed. Another issue has to do with the type of service ATS-1 has provided. It is a shared conference facility available at negligible cost (users have had to buy or build their own simple terminals, and arrange to have staff available to operate the system). Conferencing has proved to be a useful tool in the Pacific. Some ATS-1 users think that a simple replacement for ATS-1 type communication would fully meet their needs.

(5) Others think that conferencing is a very important function, but that they may require other forms of telecommunications links such as regular telephone service, and possibly access to channels for data and document transmission.

All share the view that they could not afford to use a conferencing service if current international rates for point-to-point communication were applied. International teleconferencing service is not currently available in the Pacific; however, it is technically feasible using the INTELSAT stations.

A final issue concerns the rates that would be charged for teleconferencing and other applications that have proved effective in ATS-1 experiments.

7. SOME POSSIBLE SOLUTIONS

There is not likely to be one solution to all these problems. In the near term, use of small earth stations (6 meters or less in diameter) for international communication from the smallest entities and for domestic and/or intra-regional communication with leased INTELSAT capacity may prove to be the best solution. INTELSAT is currently testing small earth stations that are designed to meet its technical performance criteria; Pacific nations should ensure that the first field tests of this equipment are in the Pacific islands.

However, INTELSAT satellites are not optimized for low volume thin route services, nor for domestic applications. Even if INTELSAT does modify future generations of satellites to include capacity for domestic regions, these advances may not be available in the Pacific where demand is relatively low. Technical designs may also have to be modified for Pacific applications, as spot beams which can be used by many developing countries for domestic communications are too narrow to cover regional communities of interest in the Pacific.

Another option may be sharing capacity with a re-

gional or domestic satellite. The PALAPA system does not extend far enough east to be of use. Australia has to date declined to add a Pacific beam to its domestic satellite for what appear to be political reasons; however, it has stated to the South Pacific Bureau for Economic Cooperation (SPEC) that Pacific requirements will be considered in the design of its second generation. The Japanese have expressed interest in providing satellite coverage for the western Pacific.

User costs will remain an important factor, no matter what system or combination of systems is used. The International Telecommunications Union's regional staff in Fiji have proposed a tariff for an audio conferencing network similar to USPNET, but using INTELSAT stations. USP would lease a block of time (e.g. 1000 hours per year) and other users such as international and regional development agencies would be able to sublease smaller blocks of time. Another approach might be the lease of off-peak time such as evenings for tutorials, and overnight time for transmission of data such as electronic messages and slow scan video pictures. (7)

Another approach might be to lease channels in a system with many other users so that common costs are shared. This approach would be similar to the medical communication network in Alaska where the Public Health Service rates are based on the percentage of utilization it makes of the earth stations. The tariff is based on number of locations rather than on point-to-point mileage. (6)

These are simply examples of possible solutions for some Pacific telecommunications requirements. The actual solutions in terms of needs, technologies, and costs will have to be worked out by the Pacific users themselves. On ATS-1 it is common for participants to switch from one site to another using the radio expression "over to ...", as in "over to Honolulu" or "over to Suva." Perhaps ATS-1 has done all it can to give its experimenters the information and experience they need to learn how satellite communications can contribute to Pacific development. Now it's "over to the Pacific" to find permanent solutions to its communication problems.

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Economic Policy Issues in Today's Telecommunications Technology

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1. Abstract

Two types of regulatory responses are possible to the proliferation of new telecommunications services and technologies. One is to continue to provide such new services by the national telecommunications entity and to protect the "sustainability" of its natural monopoly by regulating against entry by rivals. A second response is to allow liberalization of entry and competition for new services. This issue, in the Pacific Basin and elsewhere, is presently more urgent for industrialized than for developing countries, but the latter will also soon be faced with such choices as they offer more and more telecommunications services.

2. THE SUSTAINABILITY OF MONOPOLY LITERATURE

The variety of new telecommunications services, particularly at the terminal equipment level, in the past several years has presented new challenges to policy makers, engineers, economists, legal specialists, and experts from other disciplines as well.

One particularly noteworthy response at the level of economic theory has been the sustainability of monopoly literature (1), which has focused on the ability of a monopoly producing many products to retain invulnerability to profitable competition by rival firms. For a firm with only one output, declining average cost for that output assures such invulnerability, or "sustainability," of its monopoly: one firm can produce a given amount of a single output at a lower cost than could two or more firms.

Consider, however, a firm producing several outputs, with only this cost advantage: it can produce any particular combination of its outputs more cheaply than could any combination of two or more potential rival entrants. This property, technically called subadditivity of the cost function, is the analogue of "natural monopoly" for a multi-product firm.

The sustainability of monopoly literature, however, has demonstrated that multi-product monopoly in the sense of subadditivity of the cost function is often an insufficient defense against challenges of potential rivals, for the following reason: even though an entire market basket of goods and services can be provided most cheaply by the monopolist alone, potential entrants can exploit economies of scale in the production of individual product lines, undercutting the monopolist's prices for those particular products and still making a profit. Losing business on those products, however, means that the monopolist's costs and prices must rise on other items, and the overall production costs of the configuration of producers finally arrived at by competitive forces is higher than it would be if only the natural monopolist had produced the entire output.

Much of the sustainability literature, therefore, is an examination of conditions under which

multi-product monopoly is sustainable, i.e. invulnerable to profitable entry by rival firms.

There is, in addition, one obvious and extremely important policy implication in the interest of overall cost minimization for consumers: should regulatory authorities "artificially" enforce the sustainability of natural monopoly under circumstances in which the free play of cost, demand, and competition do not assure sustainability? Note how different the rationale for such intervention is than in the case of a single-product monopolist, whose natural monopoly is always sustainable. Here, regulatory intervention is justified by the possibility that the single-product monopolist will charge enough to earn "monopoly" profits and that consumers will pay more, rather than the possibility that the monopolist will be driven at least partially out of business by rival entrants and the consumer will pay more.

3. IMPLICATIONS FOR TELECOMMUNICATIONS

This paradigm applies very neatly to recent developments in telecommunications in many industrialized countries. Typically, a single national entity has enjoyed a monopoly in domestic and/or international public commercial telecommunications for many years. In the past, the limited number of different services available—predominantly telephone calls and telegrams—allowed the output or services of such entities to be conceptualized as homogeneous. Recent advances in switching and transmission techniques (packet switching, digitization, satellites, optical fibers), but even more so in the area of terminal equipment services (facsimile transmission, videotext, inter-computer links), have assured the emergence of vast new markets and services with steadily growing demand and falling prices. Now, the multi-product output monopoly model is definitely more appropriate.

At the policy level, the key issue in the emergence of these new services is the extent to which the traditional provision of telecommunications by national monopoly entities should be supplemented by some measure of competition for those services by private firms. There are well-developed and respected arguments for and against this liberalization of telecommunications regulation:

(1) In favor of only limited liberalization, one could apply the conclusions of the sustainability literature to the telecommunications sector. The implication is that if one large national telecommunications entity can provide any given basket of services more cheaply than could any combination of competitors (i.e., it has a subadditive cost function), then it should be protected against possibly profitable competition from competitors. This would minimize prices paid by consumers in an aggregate sense.

(2) In favor of broader liberalization, one can cite arguments to the effect that competition and the marketplace itself are the most efficient means of providing information about competition and its advantages or defects. Competition is seen as an "autonomous, decentralized discovery procedure" (2) superior in its information-providing abilities to the fiat of bureaucracy or the restraint of regulation. Such arguments, to the extent they are valid, will be particularly telling in the dynamic setting of telecommunications, in which the continuing emergence of new services and the exponential fall in prices due to ongoing technological progress in existing services make the rapid and efficient dissemination of information to marketplace participants particularly vital.

4. INDUSTRIALIZED COUNTRIES

In the Pacific Basin and elsewhere, it is the industrialized countries that have been the first to react to these currents and to begin to develop appropriate policy responses. The United States (3), Canada, Japan, and Australia are the major affected nations in the Pacific area. In Western Europe, it is Great Britain (4), France, and West Germany (5) that have begun most clearly to examine the policy implications of liberalization for the telecommunications industry. Other countries, particularly Italy, Sweden, and Switzerland, are also revising their regulatory apparatus to accommodate new telecommunications technology.

5. DEVELOPING COUNTRIES

At the moment, these policy issues weigh less heavily on the developing nations in the Pacific Basin and elsewhere, perhaps primarily because of the very low demand for new telecommunications services there. One can ask, however, whether the absence of a dense terrestrial telecommunications infrastructure might be a boon rather than a disadvantage as the newer technologies and services become commercially viable. Communications satellites have certainly provided an example of technological "leapfrogging" by developing countries across stages of development (dense terrestrial networks) used by the industrialized countries in the past and present. Perhaps developing areas in the Pacific Basin, for example, could examine the merits of a kind of "leapfrogging" in the regulation of telecommunications by allowing substantial liberalization and competition in that sector as new services emerge.

6. FOOTNOTES

- (1) See, for example, (3) and (6). (4) has an interpretation in a telecommunications context.
- (2) See (1) passim.
- (3) See, e.g., (2).
- (4) See, e.g., (5).
- (5) See, e.g., (1)

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Tuesday, January 19:
Banquet Keynote
Addresses

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Fundamental to the development of any communications program between countries is the development of a communications program within a country. The Pacific Telecommunications Council has a key role to play for the countries of this hemisphere as catalyst, intermediary, and supplier of advice in the formation of both national and international communications programs. This role is of great importance to the development of the economic strength and well being of the region.

Good evening - ladies and gentlemen - I am certainly very pleased and honored to share this podium with so many distinguished members of the international telecommunications and information processing communities.

I want to especially thank and congratulate President Kanahuati, the Executive Board and the Board of Directors of PTC for continuing their tradition of well-managed, meaningful programs on significant information issues. The Pacific Telecommunications Council serves an extremely important function and it is the future development of that function that I'd like to address in my remarks this evening.

Before I do, however, there is one group of people whose excellent performance I'd like to acknowledge - our translators. They have worked very hard and very professionally these past few days. I am sure it has not escaped your notice that this conference on the subject of communications relies very heavily on the process of communications to achieve its goals. Our translators have played no small part in reaching those objectives.

International communications - that, of course, is the subject of our concern - but it must not be restricted to communications between nations. Fundamental to any structure and program for communications between nations are the structures and programs to develop these capabilities within nations. Each country must first use communications and information processing to deal with its own national goals and objectives before dealing with international objectives.

However, the process is not a totally sequential one. A complete national information infrastructure need not exist before a country can venture into cooperative international development. Quite the contrary - a national

program should be built with international considerations in mind. But it must be a careful, prioritized, and synchronized process. It is in the development of well-balanced national and international programs that I think the Pacific Telecommunications Council has a key role to perform - as catalyst, as forum, as intermediary, and as supplier of technical, economic, and political advice.

I would like to spend a moment on this question of national priorities and international synchronization. It is one that is of particular concern to us in IBM. Although we must for obvious reasons have a more or less standard product line, inasmuch as our products and services are used in 127 countries worldwide, we realize that if we are to succeed in each of these countries, we must tailor our offerings to the unique needs, goals, and objectives of each individual country. That is one of the reasons why we staff our national companies with personnel from within the country.

This ensures as accurate a reflection as possible of unique national requirements and environments. If we pay close attention to what our country people are telling us, the system works and we are able to make our products and services better serve the individual needs of information users in each country.

But we are also aware that international information processing is more than the sum of its national parts. The ability to communicate and use information internationally is increasingly important as our respective national economies become more and more interdependent. And, certainly, this international communications capability will be extremely vital to the growth and development of this entire Pacific basin region.

That is why we consider organizations such as the Pacific Telecommunications Council to be so important. A national as well as international view must be maintained for an organization like the Pacific Telecommunications Council to succeed.

Needless to say, even though their long range objectives may be the same, the requirements of each country will be vastly different at any given point in time.

Therein lies the trap of international agendas. Individual countries can as a group subscribe to a set of principles such as the free flow of information, or cooperative development of telecommunications tariffs and standards, or rights of interconnection. But the priorities and techniques for creating the necessary infrastructure, and the horizons for implementation may be vastly different in the variety of countries found in the region. This is one reason why the process of fulfillment of many international agreements can be disappointing when the goals and objectives begin the slow process of transformation to action programs.

The insertion of reality - the translation of international objectives to individual national agendas - is of profound importance in making any international program work.

Back in 1943, Abraham Maslow, a noted psychologist and sociologist outlined what he called the hierarchy of personal needs. He was speaking to fellow sociologist, but I think it also applies here. His hierarchy had five levels of need - and each level demanded substantial satisfaction before the next one could be satisfied. Most basic were the physiological needs - food, drink, shelter. Next came the need for security and protection. After that came the social needs - affiliation, companionship, understanding. Next, came esteem - public or private recognition. And finally, self-actualization - internal satisfaction through self-enhancement.

This same hierarchy can be applied to nations, since ideally the needs of nations are the composite needs of its citizens. The Pacific hemisphere, as this Council defines it, is a marvelous example of the variety and complexity of national needs. With close to 4 billion people - almost 90% of the world's population - and cultural, geographic, economic, and political structures that span the entire spectrum - even the fundamental needs may look different.

Consider agriculture. In the U.S., 3% of the population is engaged in growing food, not only for the rest of the U.S. population but for a substantial export market as well. But it is of note that within the U.S. there are still substantial pockets of the population who suffer from malnutrition. Obviously production is not synonymous with availability, and even availability is of little value without the means to insure distribution to the points of need.

Compare this with many other countries of the Pacific with intense population density whose major industry is agriculture but where much of the agricultural product never goes beyond local markets. The basic need to feed the population is the same. The context and problems of production and distribution are dramatically different.

Similarly, the concepts of national security - of national identity and self-esteem - may all differ in structure but not in importance. The Pacific hemisphere taken as a composite teems with mineral, agricultural, and human resources. Yet geography, history, language, social values, as well as political and military restrictions, all tend to fragment and inhibit the sharing of the resources for the betterment of all.

I would be naive to suggest that information and communication in and of themselves will cure all these complex problems. Information cannot make natural resources appear where there are none. It can, however, open the way to substitutes, to compensating technologies, and to trade agreements which will enhance the distribution process.

So I can also say quite confidently that without adequate information and telecommunication ability, solving these problems will be vastly more difficult if not impossible.

In Cancun last October, our national leaders were unable to arrive at a formula on how to proceed on the objectives they set down. But I am certain of one thing. However those objectives are ultimately achieved, one critical dependency will be for people to communicate and exchange vital skills and information.

Therefore, while we must be careful not to create unrealistic expectations for communications and for this organization, we must also not hesitate to devote full energy to accomplishing those realistic objectives which are within our scope. I think the discussions of these past few days have shown that there is much realistic work to which the Council can devote itself.

It is therefore important that the Pacific Telecommunications Council has in its membership carriers, suppliers, researchers, users, and regulators. Each has an important disciplinary, as well as national viewpoint, to supply. The Council's function should be to coordinate and maximize the impact of that broad expertise, contributing solutions to a realistic number of realistic problems by capitalizing on new technologies and services, thus magnifying the potential individual contribution of each of the members.

We must be careful not to become too enhanced by the concept of the Pacific hemisphere itself. It is indeed an important vision giving a basis for mutual support and cooperation, but it is not the basis for a single national model. The overriding principle must be the attainment of those levels of technical, political, and economic agreement necessary to make free and full international communications possible on a global scale. This should not mean the sacrifice of national or regional identity or political philosophy, compromise on economic or social objectives, or weakening of national security.

We in IBM share the excitement and sense of purpose of this group. It has been our privilege to share in the development and supply of the most exciting and pervasive technology in the history of man. It has also been our privilege to see this technology applied in over a hundred countries in every sector of this planet. It has been our privilege to watch the Columbia Space Shuttle complete its mission under the control of our computers as well as to watch an Asian rice paddy triple its output through new strains of rice developed with the help of that same computer technology. We have helped to plan reforestation, flood control, and epidemic control, and have helped create computer generated graphics and notation to document for all time the choreographic genius of a Balanchine or an Ashton. This use of information technology has, I believe, helped to make international trade a strong and viable worldwide force for understanding, and ultimately, we pray, for peace.

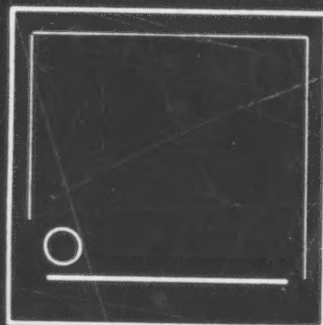
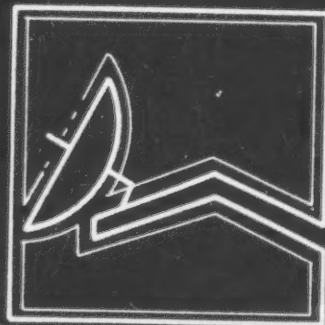
We in IBM have certainly not been alone in this endeavor. The information technology community has grown from a relatively small number of national carriers, information processing suppliers, and a few users, to become a major family of international industries and services with thousands of suppliers and billions of users. You have all been there and have provided leadership in this marvelous outreach of social, scientific, cultural, and economic interaction. This explosion has not been without its negative side. It has not been without its failures, its problems, and its potential for misuse. The power of information, like all power, must be harnessed and directed.

But this Council has within its structure and membership the knowledge, the capability and, I hope, the will to assist in harnessing and directing that power. That power can mean the betterment of all Pacific nations - industrialized or developing - Asian, Latin, North American, or Southern Pacific. It can bring a new level of economic strength and well being to all of its members. But it can also bring another great benefit - by making it possible for all countries to share more deeply in the linguistic, historical, and cultural diversity that makes the Pacific the wonderful hemisphere it is.

If we can indeed enhance the future through information and communication, this Council will truly merit the accolade that is too often extended but too seldom truly deserved - "They helped to make the world a better place in which to live."



Wednesday, January 20:
Plenary Session
Future
Telecommunications
Services



Case Study - Australian National Satellite System

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1. Abstract

This paper provides background information on a number of aspects of the decision to proceed to develop an Australian national satellite system, and on the system design. Relevant information includes the Australian geography, climate, and population distribution, the terrestrial telecommunications system, and the broadcasting scene in Australia. The main services to be carried via the satellite system are described, together with the details of the system design against which tenders were called.

2. STATUS OF THE PAPER

At the time of writing this paper (October 1981) tenders for both the space and earth segments of the Australian National Satellite System were being assessed. Furthermore, the current expectation was that the decisions on contract award would not be known by January 1982, the date of the 1982 Pacific Telecommunications Conference.

Accordingly, the case study outlined in this paper draws heavily on material available in the period prior to closing of tenders (May 1981) and is heavily based on expectations developed during the system design stage, which ended with the release of the Request for Tender in October 1980. No material included here reflects the content of any tender for any element of the system.

3. AUSTRALIA - GEOGRAPHIC, CLIMATIC AND DEMOGRAPHIC BACKGROUND

Australia is a large country, some 7.7 million square kilometres in area, with a population of some 14 million and a population growth rate of around 1.2%. The great majority of the people live along the eastern and south-eastern seaboard.

Figure 1 illustrates the population distribution in Australia, and shows the concentration of population on the narrow eastern and south eastern coastal strip with a substantial relatively isolated centre of population in Perth some 3,000 km from Melbourne. The coastal strip referred to includes over 80% of Australia's population and the majority of industries, excluding the primary and mining sectors.

More specifically, population is heavily concentrated in the major cities, as follows (1978 figures):

Sydney	3.15 m
Melbourne	2.72 m
Brisbane	1.00 m
Adelaide	0.93 m
Perth	0.86 m
Hobart	0.17 m
Canberra	0.23 m
Darwin	0.06 m

Another feature is large areas of grazing country with individual properties of area measured in thousands of square kilometres. Population is thus very thinly spread in this region.

There are quite large aboriginal communities in the more remote parts of Australia, particularly in the Northern Territory, Queensland and Western Australia.

The Australian climate ranges from arid deserts to tropical rain forests. Temperatures in the desert areas can range from below zero to as high as 53°C with average shade temperatures around 40°C for long periods. The coastal regions in the northern half of Australia are subject to heavy rain and cyclones. Annual rainfall can approach 5 metres per year in the wettest areas of Australia. Wind gusts, particularly associated with cyclones, have been recorded at up to 230 km/hr.

Some 38% of the continent has a rainfall of less than 25 centimetres per annum and is not suitable for grazing or other rural occupations. Important mining undertakings occur at a number of points in this dry belt and there is tourist activity which is growing.

4. TERRESTRIAL TELECOMMUNICATIONS

Some 98% to 99% of the entire population lives in areas served by the existing national telecommunications network. The present broadband telecommunications links extending around the coast may be followed in a clockwise direction from Darwin to Port Hedland and extend services to all the more heavily populated regions (Fig. 2). Lower capacity systems

POPULATION DISTRIBUTION

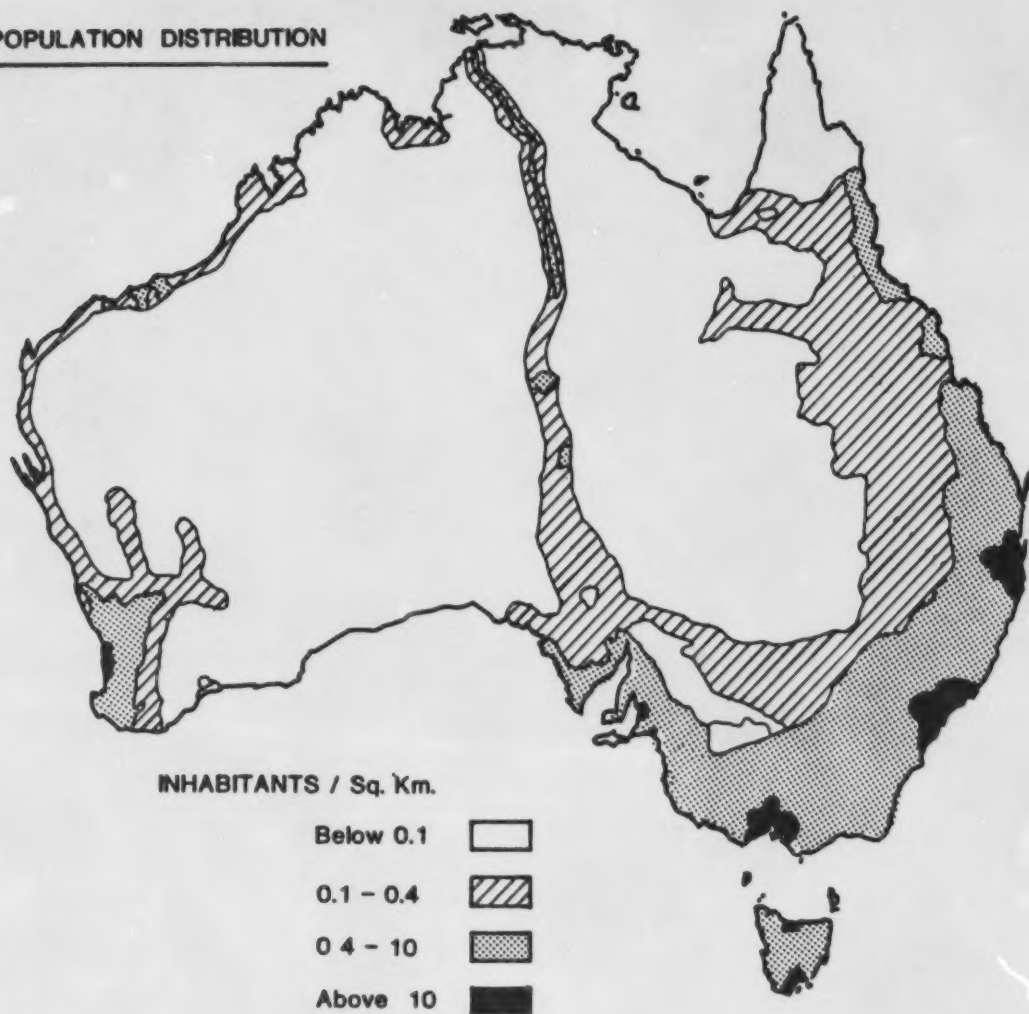
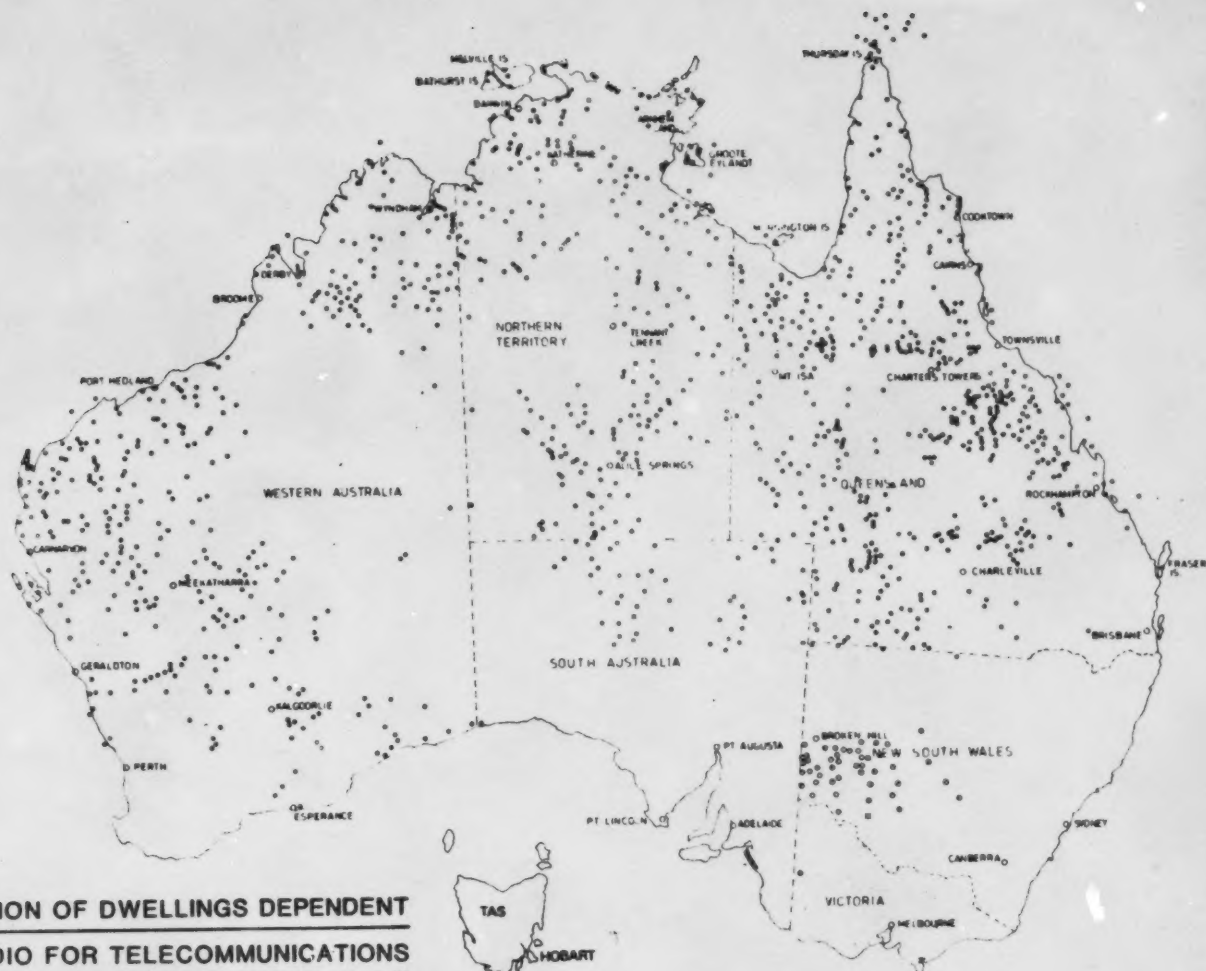


FIGURE 1.

[illegible]

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DISTRIBUTION OF DWELLINGS DEPENDENT
ON HF RADIO FOR TELECOMMUNICATIONS

FIGURE 3.

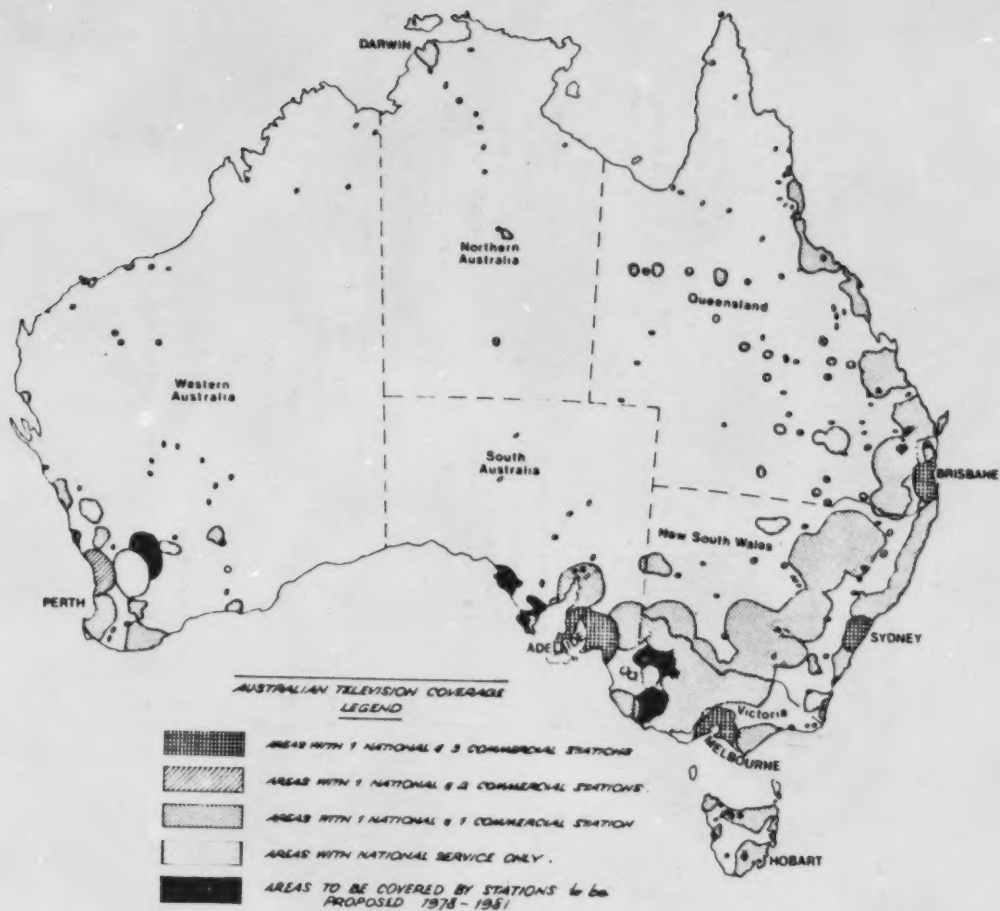
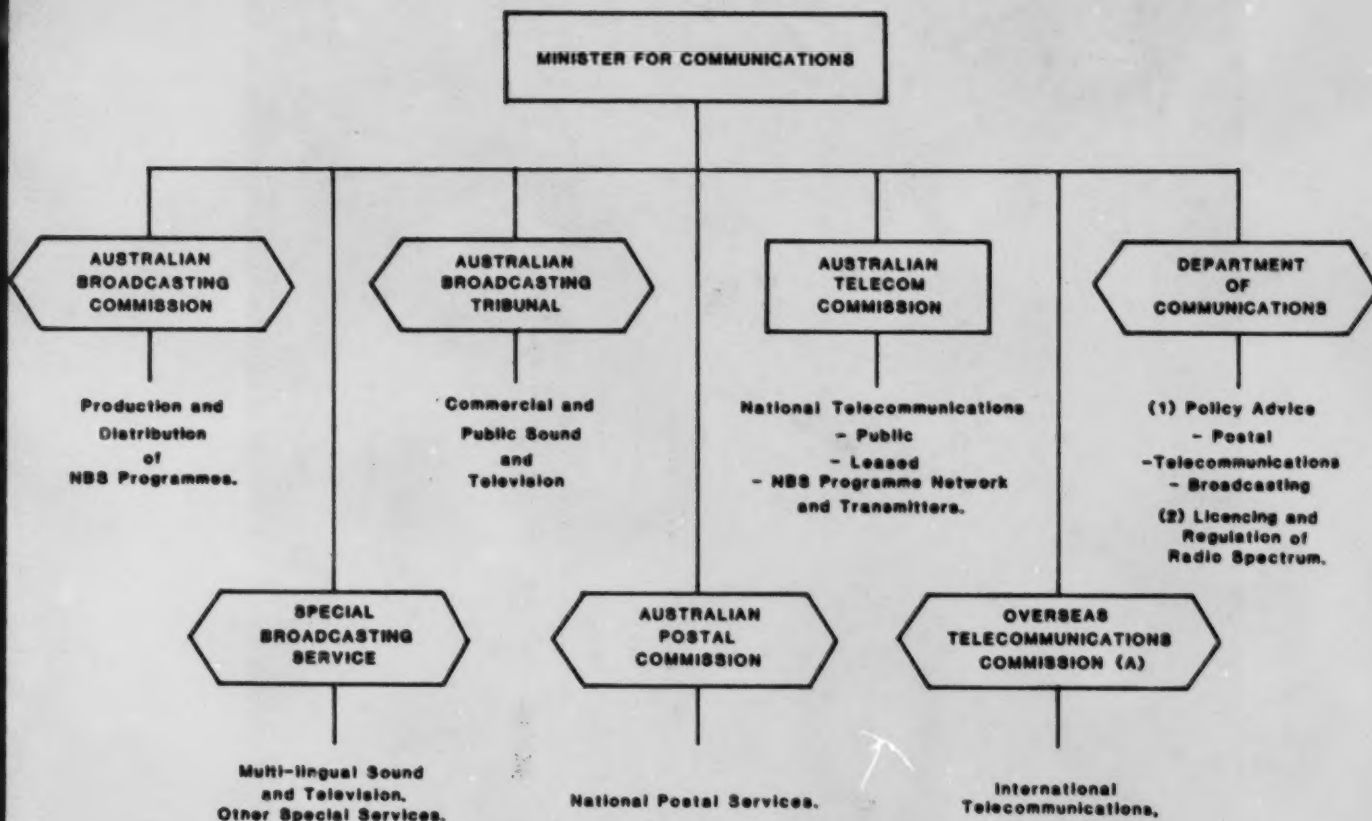


FIGURE 4.



TIMETABLE

<i>OCTOBER 1979</i>	<i>GOVERNMENT DECISION IN PRINCIPLE TO PROCEED</i>
<i>SEPTEMBER 1980</i>	<i>GOVERNMENT DECISION TO ISSUE RFT</i>
<i>OCTOBER 1980</i>	<i>ISSUE OF REQUEST FOR TENDER (RFT)</i>
<i>MAY 1981</i>	<i>CLOSING DATE FOR TENDERS</i>
<i>EARLY 1982</i>	<i>ORDERS PLACED FOR SPACECRAFT</i>
<i>MID 1982</i>	<i>ORDERS PLACED FOR EARTH STATIONS</i>
<i>EARLY 1985</i>	<i>FIRST LAUNCH OF SPACECRAFT</i>
<i>FIRST HALF 1985</i>	<i>SYSTEMS OPERATIONAL</i>

FIGURE 6.

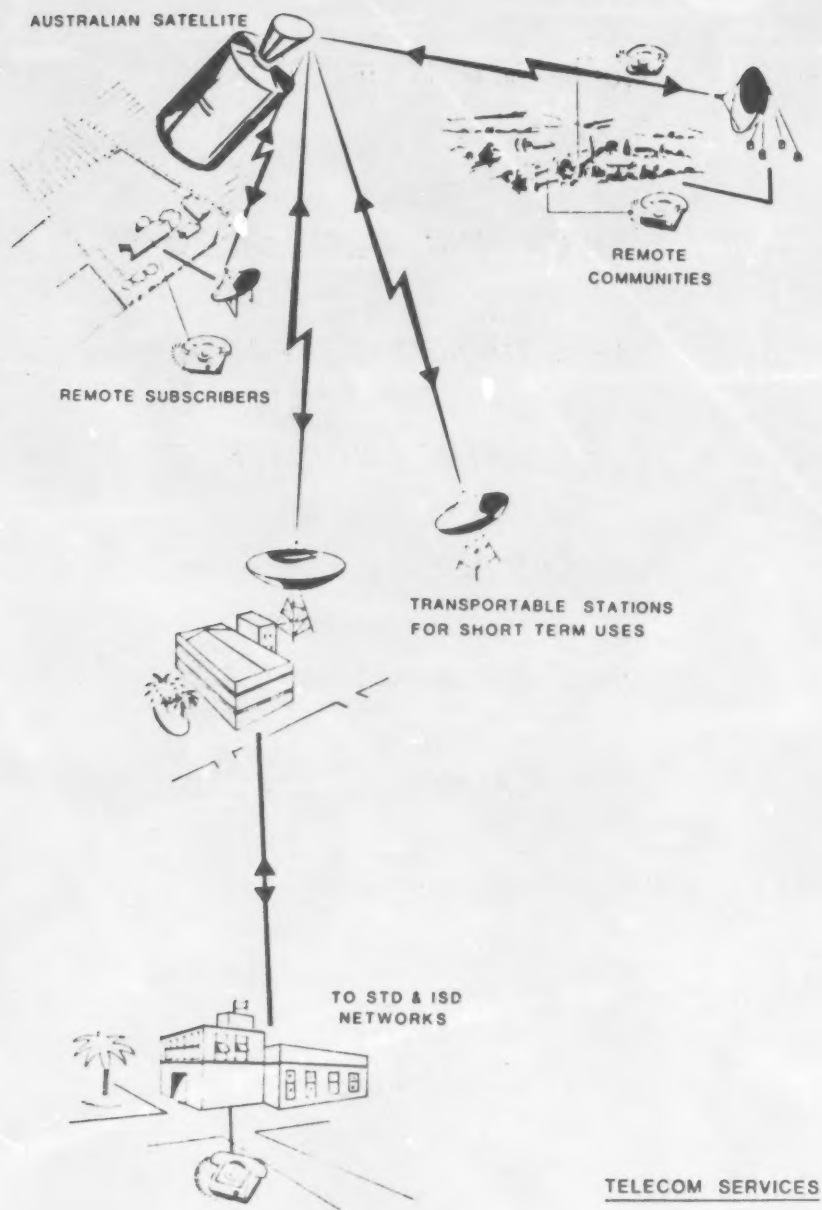
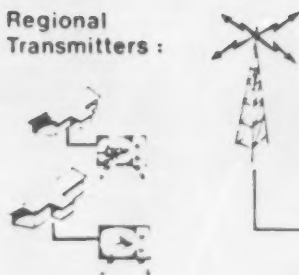


FIGURE 7.

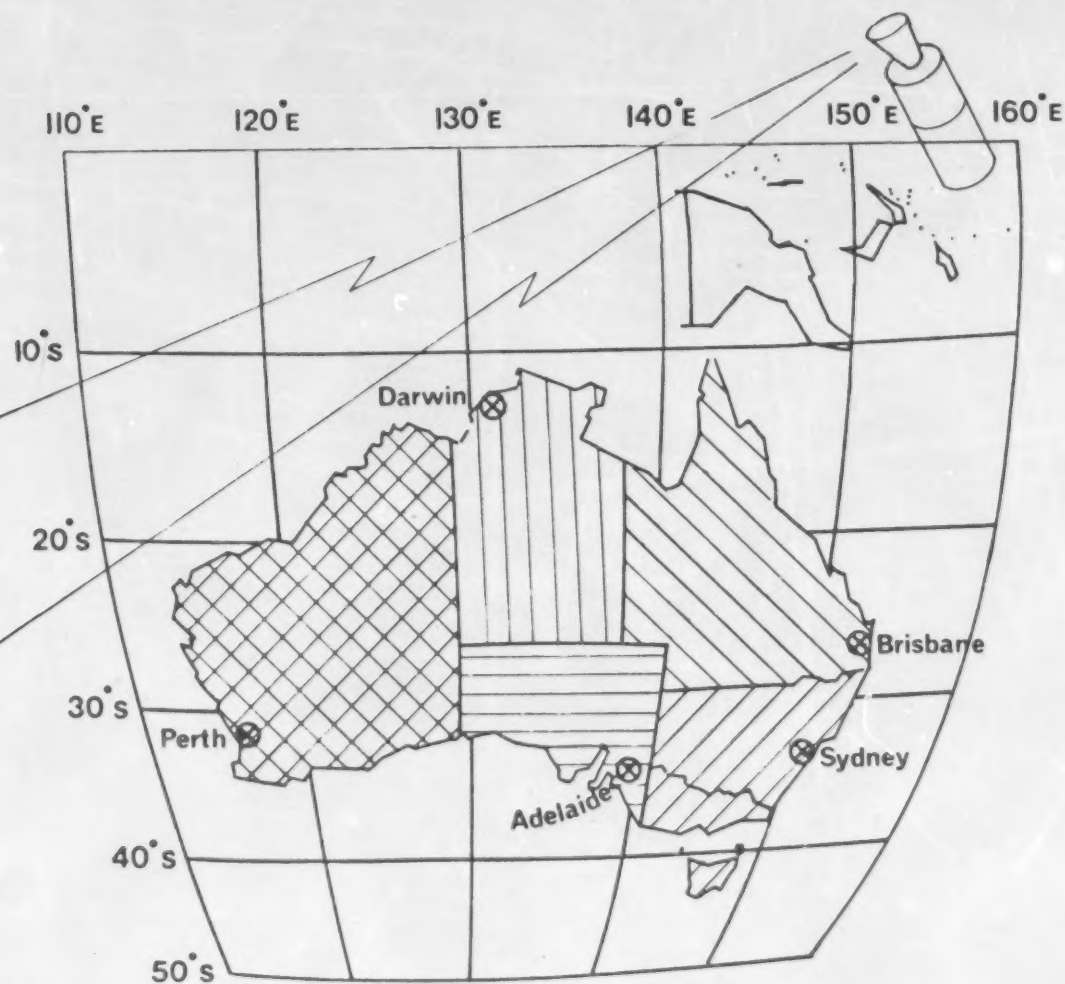
Direct Broadcasting
to Remote
Homesteads :



Regional
Transmitters :

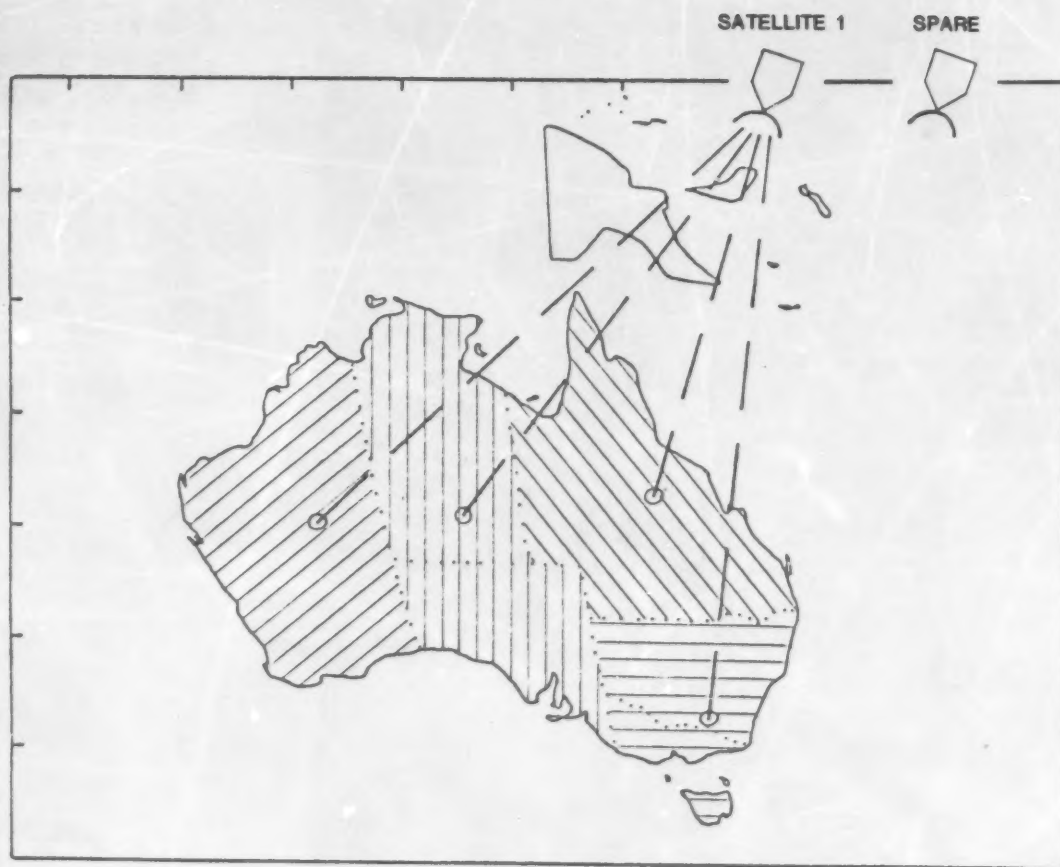


PROGRAM SOURCES
AND REGIONAL
SERVICE AREAS.

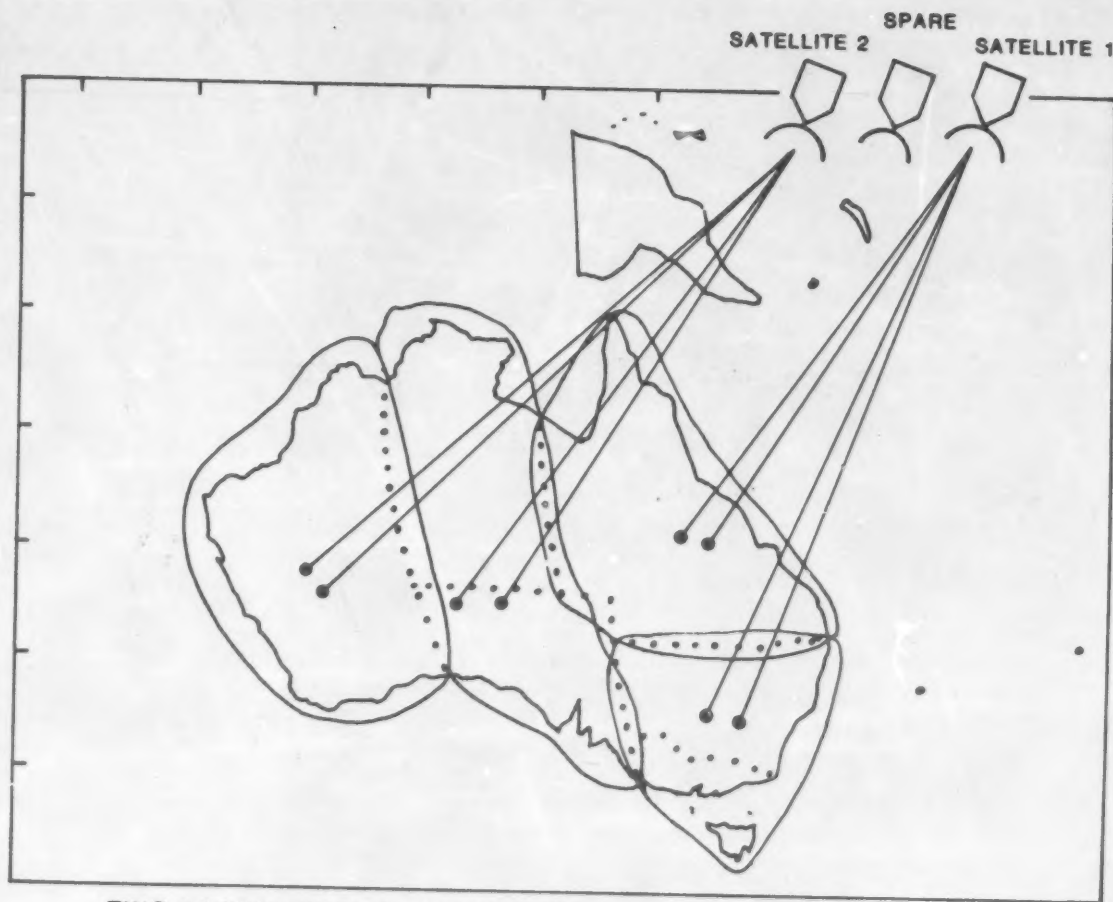


HOMESTEAD & COMMUNITY BROADCASTING SATELLITE SERVICE

FIGURE 8.

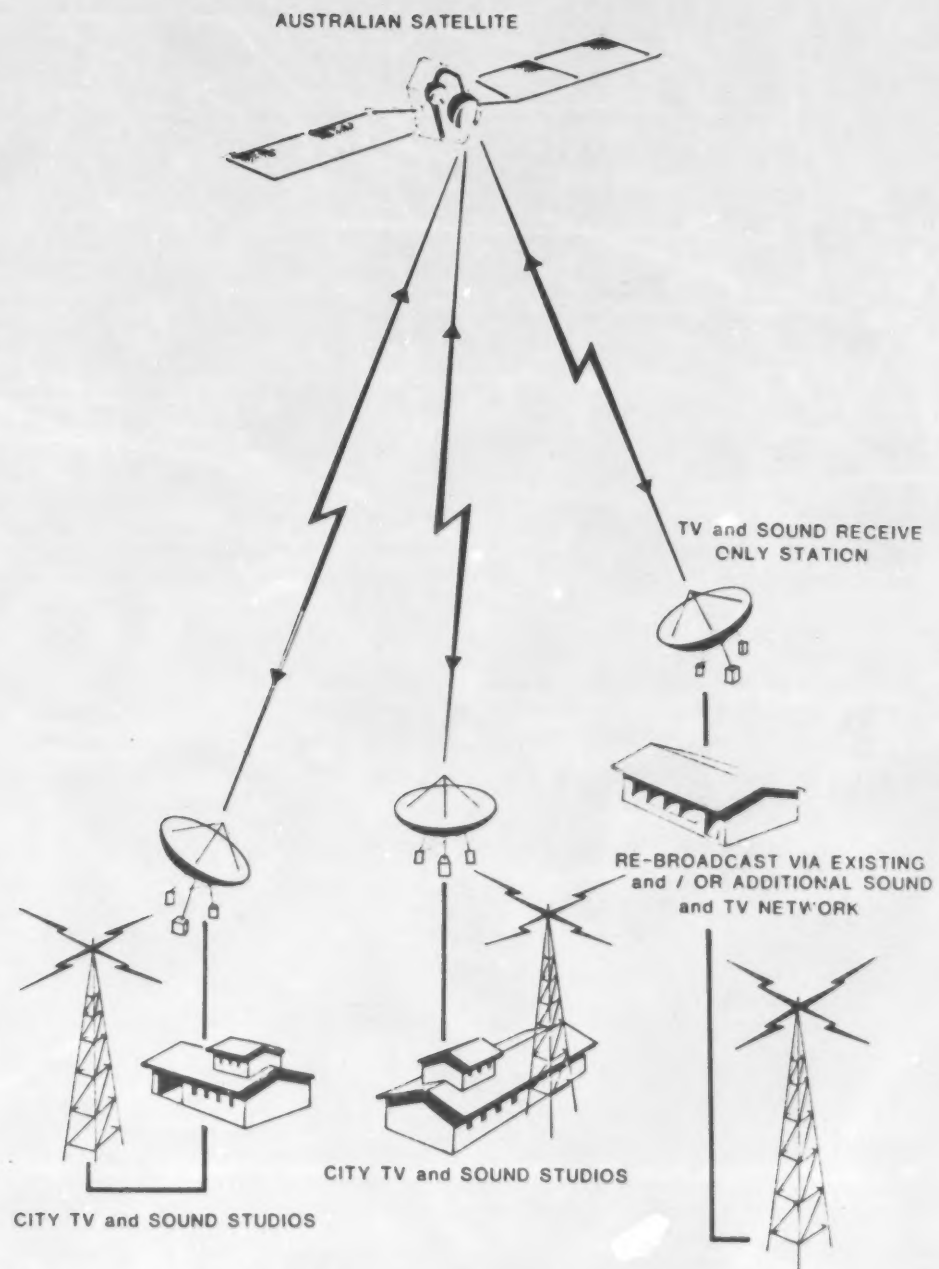


ONE HACBSS SERVICE THROUGH ONE OPERATIONAL SATELLITE



TWO HACBSS SERVICES THROUGH TWO OPERATIONAL SATELLITES

FIGURE 10.



TELEVISION AND SOUND BROADCASTING RELAY REQUIREMENTS

FIGURE 11.

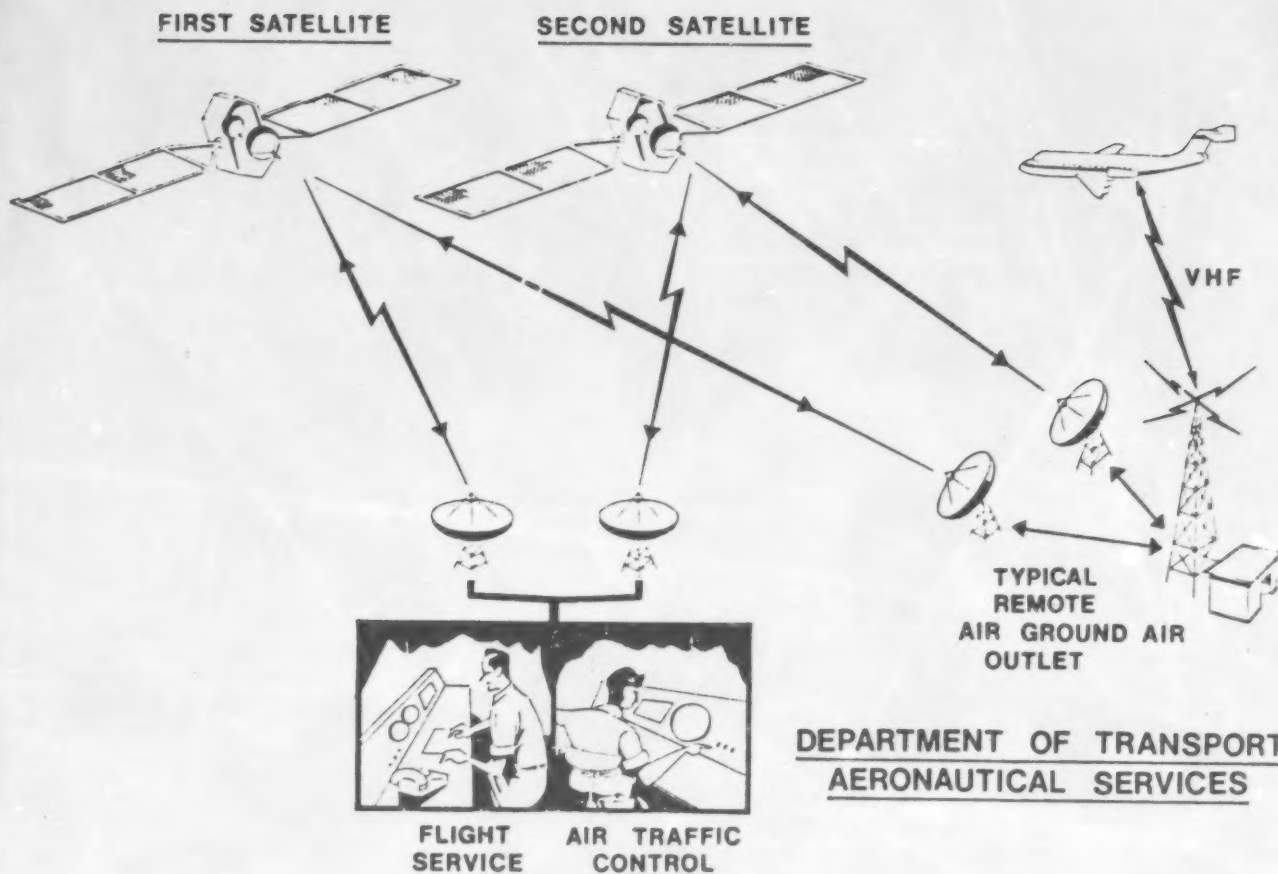
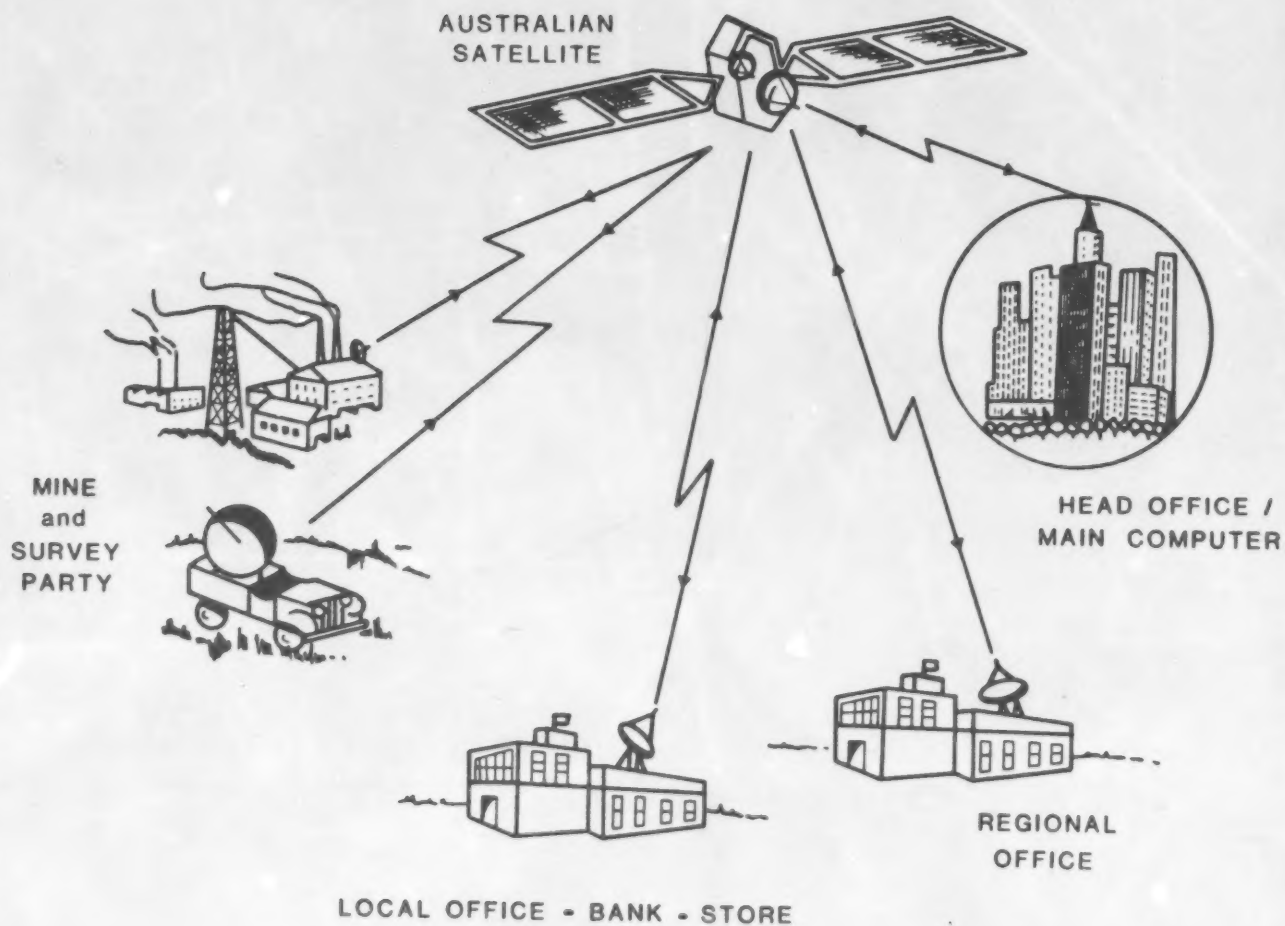


FIGURE 12.



BUSINESS DATA NETWORKS

FIGURE 13.

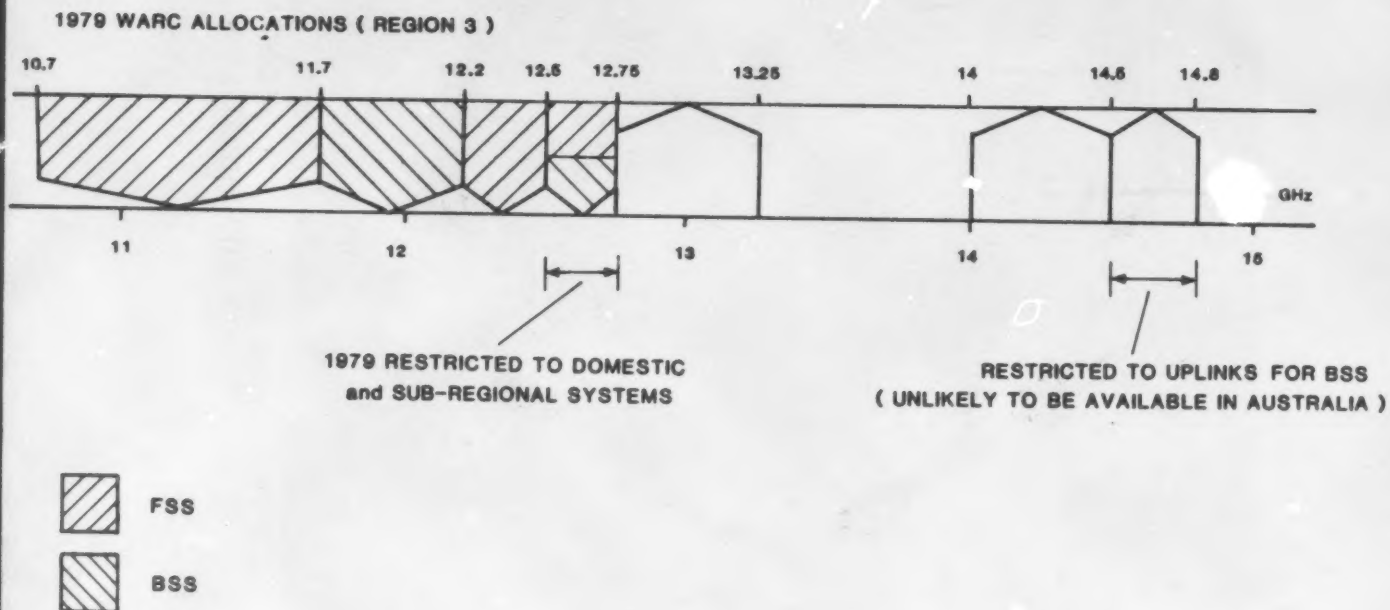
SUMMARY OF
TRANSPONDER REQUIREMENTS

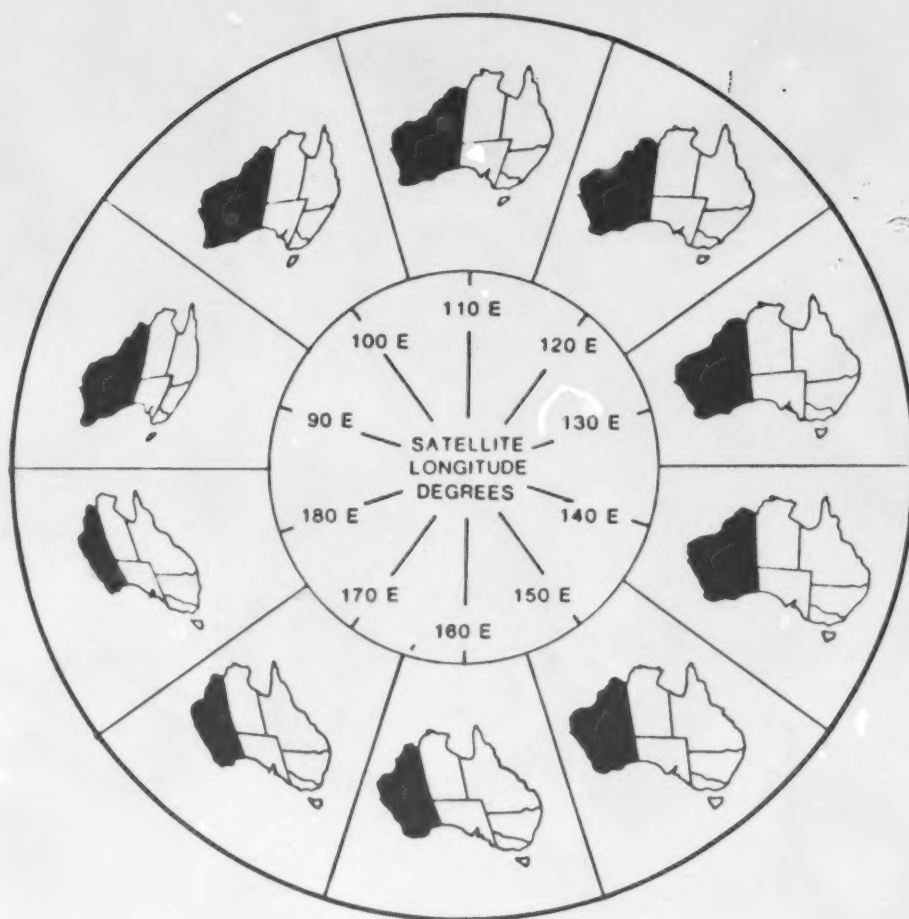
NATIONAL BROADCASTING (ABC)	8
COMMERCIAL BROADCASTING	7
DEPT. OF TRANSPORT	4
TELECOM	1
OTC(A)	1
SERVICES FOR PNG	3
SECOND HACBSS CHANNEL	4
DATA, ITINERANT USE, SPARES	3
	31

OUTLINE OF NATIONAL SATELLITE SYSTEM

- . 15 TRANSPONDERS**
- . DOWNLINK-NATIONAL BEAMS PLUS 4 SPOT BEAMS**
- . UPLINK-NATIONAL BEAMS**
- . FREQUENCY BANDS - 12 GHz DOWNLINK
- 14 GHz UPLINK**
- . SATELLITE LIFETIME 7 YEARS**
- . ORBIT LOCATIONS 156° E AND 164° E**
- . FULL ECLIPSE BATTERY CAPACITY**
- . COVERAGE OF PNG**

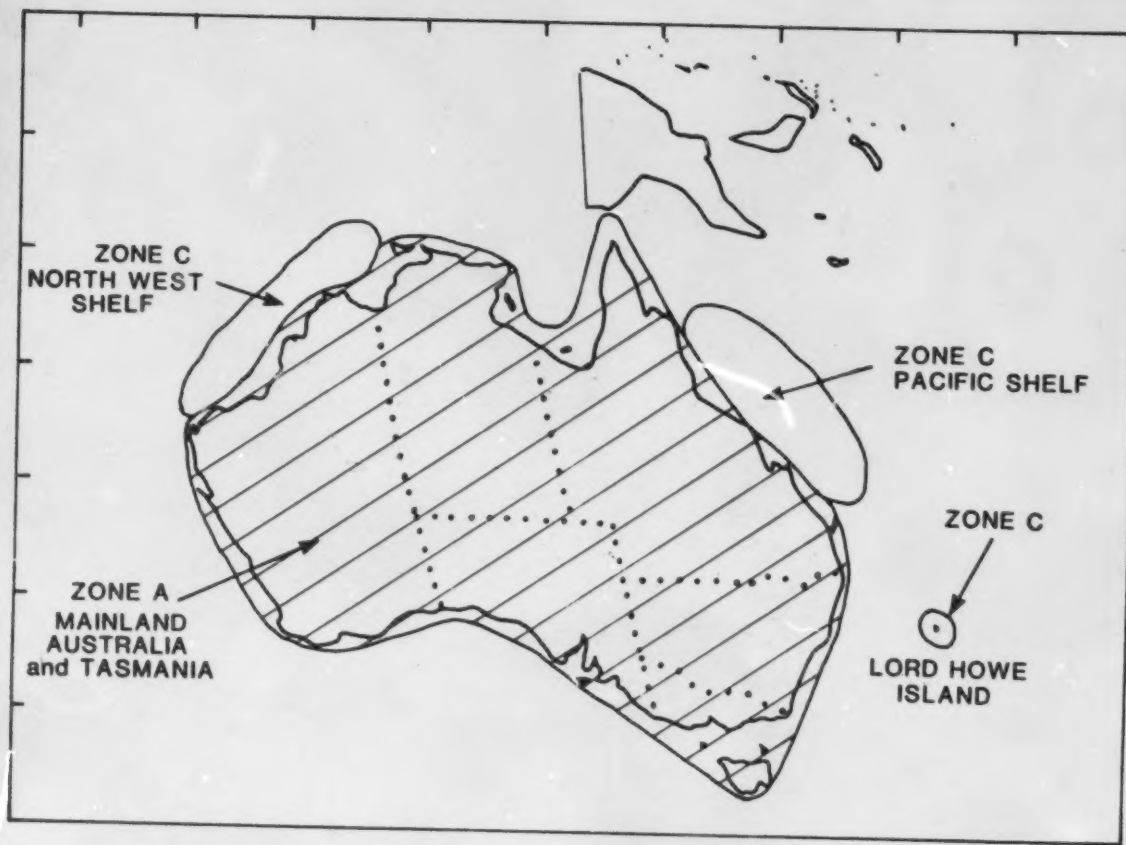
INTERNATIONAL FREQUENCY BAND ALLOCATION





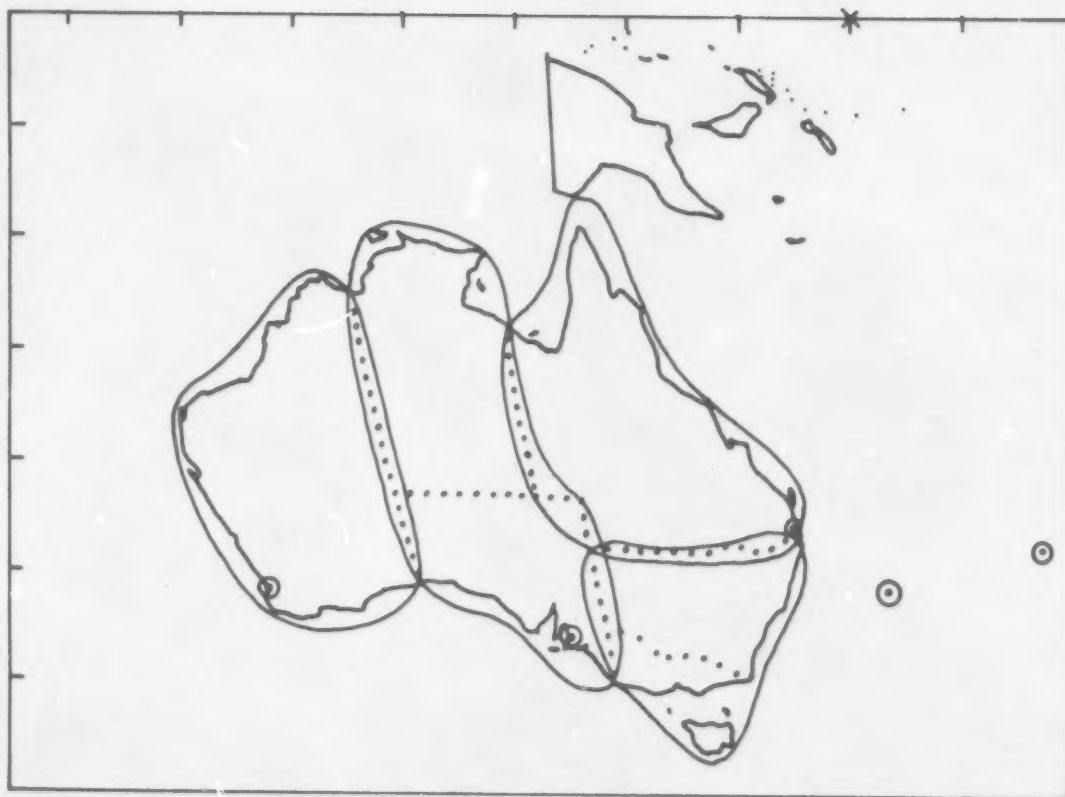
AUSTRALIA AS SEEN BY A GEOSTATIONARY
SATELLITE AT DIFFERENT LONGITUDES

FIGURE 17.

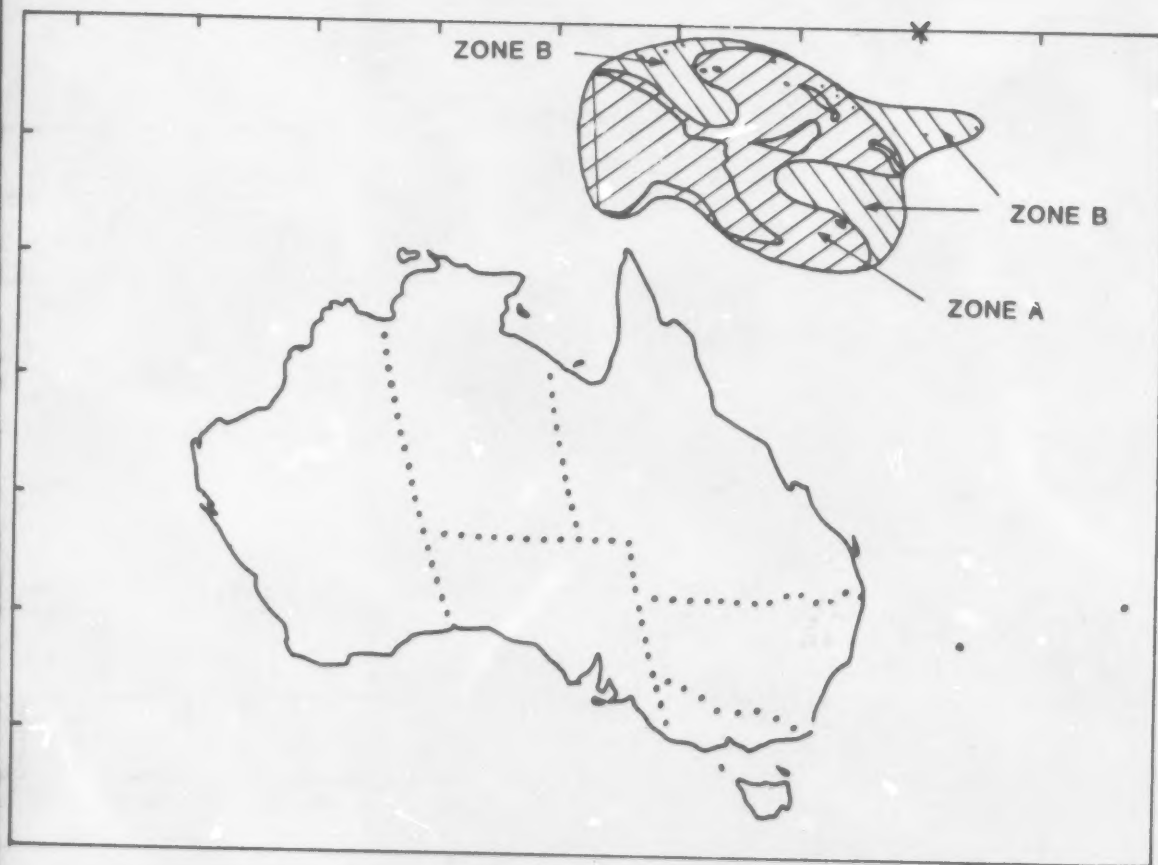


NATIONAL BEAM FOR BASELINE SPACECRAFT DESIGN

FIGURE 18.

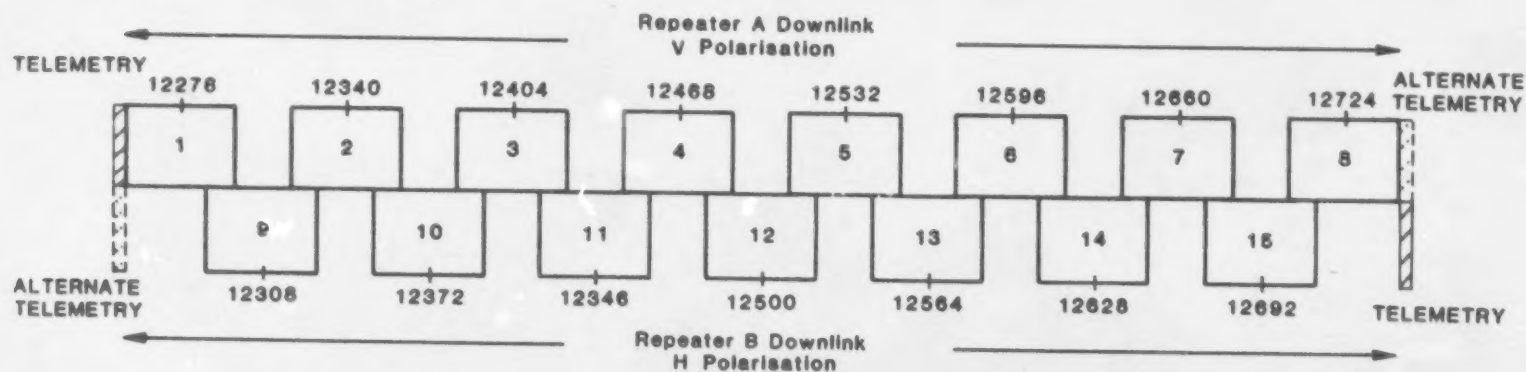
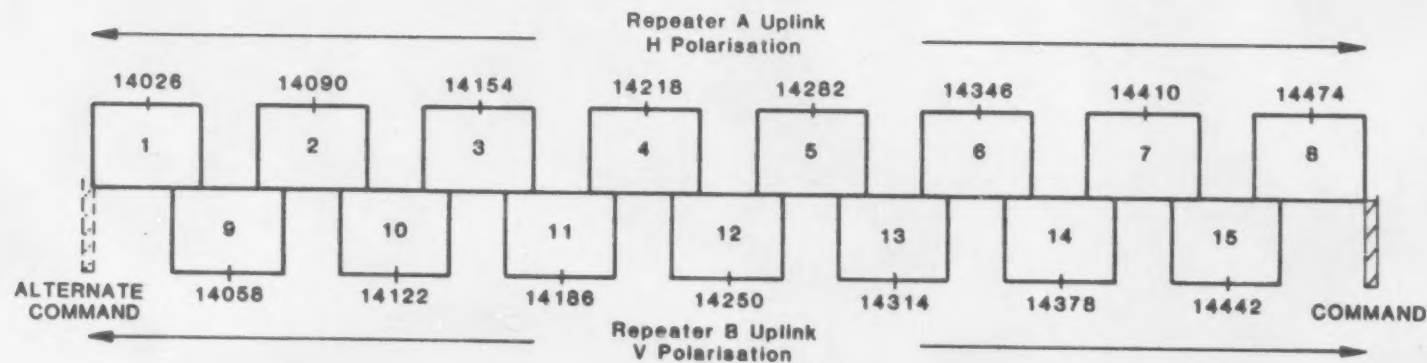


AUSTRALIAN NATIONAL SATELLITE SYSTEM
TRANSMIT SPOT BEAMS



PAPUA NEW GUINEA SPOT BEAM

FIGURE 20.



FREQUENCY PLAN

(Transponder Centre Frequencies are in MHz)

FIGURE 21.

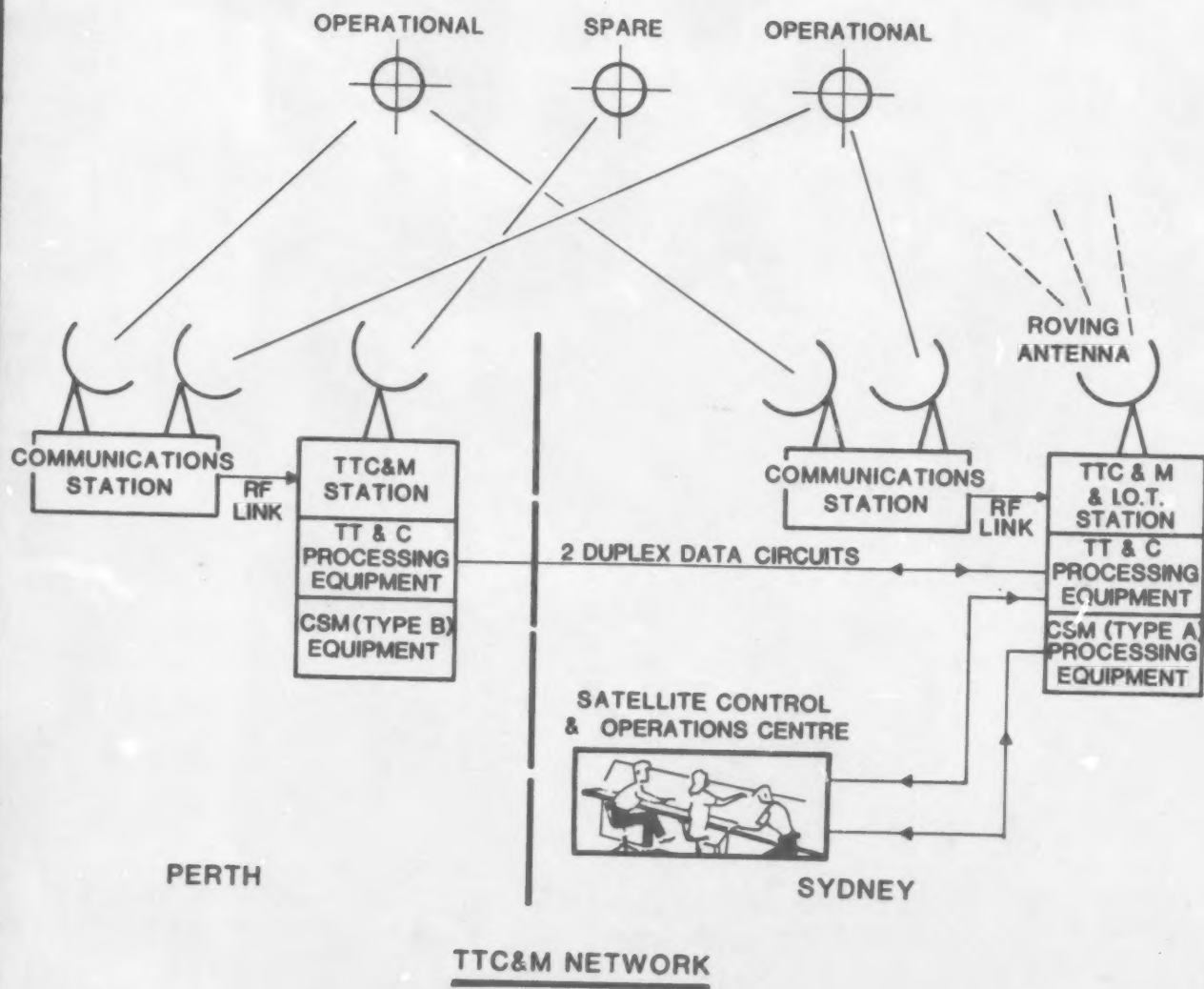


FIGURE 22.

connect the less densely populated hinterland to the network. The central and northern areas of Australia are very sparsely populated and pose substantial technical and economic problems for the provision of a full range of modern communication facilities.

Beyond the reach of the existing telephone services are large geographic areas with a very low density of population - the "remote areas". These areas are characterised by very large highly mechanised pastoral properties, sometimes many hundreds of square kilometres in area, controlled from a homestead housing perhaps ten to twenty people. In addition there are some remote islands where a small number of services may need to be provided.

As illustrated in Figure 3, existing remote area communications are provided by high frequency (HF) radio through services such as those of the Royal Flying Doctor Service (RFDS), the School of the Air, the Northern Territory Aerial Medical Service (NTAMS), Telecom and others. Apart from those served by the Telecom HF radio networks, the telecommunication links with the national network are limited to telegrams passed over the RFDS and NTAMS services and a trial scheme which interconnects some RFDS services to the Telecom network. Whilst HF radio networks provide an invaluable service, the quality and reliability of the service are subject to the anomalies of HF propagation and interference. The HF networks do not provide an automatic service nor do they include privacy equipment. The first communication priority in these areas is clearly for a good quality automatic telephone service.

Estimates suggest that there are some 3,000 isolated homesteads with a population of 10,000 to 12,000 people, 30-40 communities containing 24,500 aborigines in settlements or missions, and 2,500 people in mining centres, altogether a total of 38,000 to 40,000 people, who will remain beyond the reach of the telephone network using terrestrial techniques by 1985 and beyond. Use of a satellite system will permit the extension of telecommunications services to these isolated people through small earth stations which could also be used for television and radio reception.

Furthermore, the provision of television coverage to remote areas is limited, and is represented in the map at Figure 4. Statistically, the situation as outlined in Table 1 existed in 1978, when the National Satellite Task Force was examining the factors which would lead Australia to a decision to introduce satellite communications.

TABLE 1

Deficiencies in the National Television Coverage

	Number (Millions)	%
Population with no TV service, and with		
- service capable of being provided terrestrially	0.37	2.6
- no prospect of service being provided terrestrially	0.12	0.9
Population with impaired service capable of being improved by terrestrial means	0.91	6.5
Total population with impaired service or no service	1.40	10.0

In summary, the populated areas of Australia are served with telecommunications services via a terrestrial network based on microwave and coaxial cable systems. The remote areas suffer from lack of telephone and broadcast (television and radio) services, and in the majority of cases communications is via HF radio networks, with their attendant poor and variable quality.

The "resources boom" in Australia, with an emphasis on mineral exploration and production, has placed and will continue to place heavy demands on reliable telecommunications to remote areas.

Education of primary school children living in remote locations is undertaken by the "School of the Air", typically with six children communicating with their teacher (but often not with each other) via "press-to-talk" HF radio links, for one hour per day. This less-than-ideal arrangement is normally supplemented by correspondence lessons, and there is clearly great scope for improvement in the quality of this service via improved communications.

5. THE BROADCASTING SCENE IN AUSTRALIA

The broadcasting environment in Australia is based on two major components:

- the National Broadcasting Service, provided by the Australian Broadcasting Commission (the ABC), a wholly Government-owned authority;
- commercial broadcasting stations, licensed to operate services and having a profit motivation.

Figure 4 reveals the distribution of television services within Australia, and highlights:

- the considerable area not provided with any service at all;
- the limited choice of programs available to many Australians in areas distant from the main centres of population;
- the difficulty of servicing the areas described above by terrestrial means.

It should be noted that the ABC provides the only true "network" in Australia, since the commercial stations are currently prohibited by legislation from networking in the North American sense. Furthermore, the ABC operates its services on a State rather than fully national basis, essentially originating programs in each State from the State capital city.

The ABC already distributes some television programs via the INTELSAT system, with programs uplinked via OTC(A)'s Moree and Carnarvon INTELSAT earth stations serving over 40 receive-only earth stations feeding terrestrial transmitters.

6. ORGANISATIONAL/INSTITUTIONAL ARRANGEMENTS IN AUSTRALIA

The organisational/institutional arrangements for communications and broadcasting in Australia are set out in Figure 5.

Essentially:

- telecommunications services are provided by the Australian Telecommunications Commission (Telecom) and the Overseas Telecommunications Commission (Australia) (OTC(A)), which have, with minor qualifications, monopoly rights to provide the domestic and international services respectively;
- broadcasting services are provided by the ABC and by licensed commercial operators;
- the Department of Communications provides policy advice to the Minister, to whom the above Commissions report, and also has responsibility for licensing and regulation of the radio spectrum.

In recent years there has been a strong move within Australia, particularly from the business sector, to have the above arrangements modified by permitting competition with Telecom, particularly in the provision of services to the end-users. The national satellite system is seen by some as a catalyst for the introduction of such arrangements.

7. AUSTRALIAN NATIONAL SATELLITE SYSTEM - HISTORY

It will be clear from the information set out above that a number of factors suggest the desirability and value of Australia utilising satellite facilities to enhance the terrestrial communications and broadcasting networks. These factors may be summarised as:

- provision of services to remote areas;
- provision of capacity for broadcasting program distribution to terrestrial transmitters;
- provision of diversity capacity to strengthen the reliability of the existing terrestrial telecommunications network.

Against the above background, the key points in the decision making process to date have been:

- study by Telecom of the desirability of introducing satellite capability - a number of years up to 1977
- provision to the Government of a report prepared for Publishing and Broadcasting Ltd (a large commercial television operator), recommending the introduction of an Australian satellite system - August 1977
- study of the proposition:
 - by a Government established Task Force November 1977 - July 1978
 - subsequently, by a Government established Working Group October 1978 - August 1979
- decision in principle by the Government to proceed to establish a national satellite system, including establishment of a Satellite Project Office - October 1979
- issue of Request for Tender for the space segment, together with a range of classes of earth stations - October 30, 1980
- receipt of tenders - May 4, 1981.

8. FUTURE TIMETABLE

The future timetable is contained in Figure 6 and includes the following key milestones:

- Government decision to let spacecraft contract - March 1982
- launch of first spacecraft - first half 1985
- system operational - mid-1985

9. SERVICES TO BE PROVIDED

The system design flowed from a definition of the services to be provided via the system, based on an understanding, developed from a range of inputs, of the needs of the Australian community. The services to be provided are illustrated in Figures 7 to 13 and are briefly described below.

9.1 TELEPHONE SERVICES FOR REMOTE AREAS - FIGURE 7

Telecom envisages use of the system as a means of providing telephone services to remote homesteads or communities out of the economic reach of terrestrial systems. Accordingly, provision was made in the system design for a capability to operate small earth stations (antenna diameter 2.5 - 3 metres) of capacity 1-12 voice circuits, linked via the satellite to an appropriate terminal exchange. Separately, reception of HACBSS television and sound programs as described in the next section will be accommodated by the addition of optional ground equipment.

Separately, the prospect of using small transportable earth stations to restore service in catastrophic circumstances or large transportable earth stations to cover gaps in works programs for terrestrial broadband capacity was also identified by Telecom and canvassed in the RFT.

In a timeframe more-or-less paralleling the satellite system design process, Telecom called tenders for a digital radio system, operating in the UHF band, also designed to provide the capability to bring telephone service to some of the more remote elements of the population. It is expected that case-by-case decisions will be taken as to the preferred technical means of satisfying the telephone needs of the remote user.

9.2 BROADCAST SERVICES FOR REMOTE AREAS - FIGURE 8

The desirability of providing television and radio services to remote areas was a key element in the decision to proceed. Fundamental to this service requirement is the need for the remote earth stations to be:

- a consumer product
- relatively cheap (target \$1,000 per unit)
- of small diameter (1.2-1.5 m)
- capable of being transported and installed by the consumer
- capable of withstanding the harsh environment of remote areas in Australia.

The service requirement was identified as a capability to receive:

- one or two television programs (i.e. the ABC plus one other television program);
- up to two AM and one FM stereo sound programs (this is the full range of ABC originated sound programs).

The service was called the Homestead and Community Broadcasting Satellite Service (HACBSS).

Clearly, the HACBSS service will be an early example of a direct broadcasting service. However, since the design parameters provide lower flux densities than is prescribed for a true Direct Broadcasting Service a new name was deliberately selected.

The HACBSS service was a key factor in the overall system design. In particular:

- the requirement for the HACBSS receive only earth stations to be of small diameter required the allocation of significant power to HACBSS transponders (nominally 30W compared to 15W for the other transponders);
- the system design had to be capable of catering for either one or two HACBSS television services: Figures 9 and 10 illustrate the arrangements envisaged to meet this requirement.

9.3 INTERCHANGE AND DISTRIBUTION OF TELEVISION PROGRAMS - FIGURE 11

The ABC requirement may be summarised as follows:

- interchange of programs between television studios as contributions to program development; the ABC has ten studios located at the capital cities (Sydney, Melbourne, Brisbane, Adelaide, Perth, Hobart, Canberra and Darwin) and two provincial cities in North Queensland (Townsville and Rockhampton)
- distribution of programs from the originating studio to the terrestrial transmitters taking that program (essentially seven State-oriented networks).

The ABC currently makes use of a number of techniques to meet the above requirements, including the Telecom broadband network, the INTELSAT Pacific Ocean Satellite, and bicycling of tapes from station to station.

The major commercial operators have similar requirements, although the current legal limitation on networking needs to be considered in assessing their total requirement. Put another way, removal of that limitation (which is being pressed by the major commercial television interests) would increase their potential use of the system significantly.

The ABC also has an interest in distributing radio programs via the satellite system, while commercial radio operators have shown less interest due to the essentially local nature of such services.

9.4 TRANSPORT COMMUNICATIONS - FIGURE 12

Communications between aircraft and air traffic control centres in Australia could be greatly enhanced by the use of satellite communications facilities. Currently, VHF stations providing air-ground-air communications capability are linked to control centres by terrestrial facilities, leading to limitations on the possible locations of the VHF stations, particularly in remote areas, because of the limitations of the terrestrial system. The enhanced freedom of locating VHF stations arising from the use of satellite links rather than the terrestrial system is seen by the Department of Transport as valuable in a number of ways.

The safety of life aspect of such communications imposes on the system a need for great reliability, and the DOT proposes to meet this by the provision of duplicate antennas at all locations, operating via each of two satellites in a redundancy/diversity mode.

9.5 BUSINESS SERVICES - FIGURE 13

A range of business services is envisaged, centred particularly around major cities, but clearly communications with remote areas (mining communities for example) is also seen as very important. Flexibility of location of earth stations is a key element in this approach.

9.6 SERVICES FOR OTHER COUNTRIES

During the investigation by the National Satellite Task Force (November 1977 - July 1978), Papua New Guinea and New Zealand were invited to participate in the work of the Task Force by providing observers, and both countries accepted the invitation. The objective was to identify any prospective desire to use the system for domestic PNG or NZ services. Further contact was made with both countries during the system design stage.

In the event:

- NZ indicated that it had no interest in using the system, at least for the first generation of Australian satellites;
- PNG expressed an interest in using the system, for purposes similar in nature to some of those applying for Australia, namely:
 - provision of telephone service to the remote areas of PNG

- distribution of a television service from Port Moresby to the remainder of the country, in the event that the PNG Government should decide to introduce such a service.

The system design provides capability, if required, for such services within PNG.

Late in the design stage, representations were received from the South Pacific Island Countries for the Australian satellite system design to be such as to provide for communications capability within that region. Following very detailed investigation, it was concluded that the design of satellite system developed specifically for Australian national communications could not successfully be modified to provide additional capability for the South Pacific area as well. However, the Australian Government agreed to join in a study designed to identify appropriate solutions for the communications needs of the South Pacific countries.

9.7 SUMMARY OF USERS' REQUIREMENTS

At the time of calling tenders, the sum total of the capacity requirements of prospective users was in the order of 31 transponders, as set out in Figure 14. The potential user requirements were developed as a result of considerable discussions with a wide range of organisations, both Government and private. There was, of course, no commitment on the part of potential system users to convert the potential to a firm order, nor was there a clear picture of the timing with which particular users might decide to utilise the system. The absence of a firm tariff policy (in the absence of firm cost information) was a major factor in this lack of clarity. Nevertheless, the level of interest established by potential users, as summarised in Figure 13, was a helpful input to system dimensioning.

10. SYSTEM DESIGN

The approach to system design was based on a number of factors, including:

- consultation with potential system users, in both the public and private sectors, to gain the best possible understanding of their needs;
- the use of consultants (COMSAT and ESA) to supplement the skills available in the design team;
- the need, stated by the Government, to have available full cost information on those elements of the system to be funded in the public sector, leading to a decision to call tenders simultaneously for the space segment and a number of classes of Government-owned earth stations;

- the decision of the Government, announced at the time of the decision in principle to proceed (October 1979), that users would be permitted to own earth stations;
- consultation with potential tenderers by:
 - . establishment of a three-day Briefing for Industry during the design phase, in order to reveal the approach being adopted and to gain feedback from industry;
 - . release of draft specifications, particularly for the space segment, in advance of the formal release of the RFT, in order to ensure if possible that no prospective tenderer was discouraged from bidding by particular elements of the RFT.

The space segment design presents a challenge to manufacturers worldwide as it represents about the limit in performance, complexity and capacity which can be reliably extracted from a Delta-sized spacecraft using current technology. Design features which have been incorporated into the spacecraft include:

- operation at Ku-band
- frequency re-use through orthogonal linear polarisations
- multiple shaped antenna beams
- transmit beam switching
- high and low power transponders with commandable gain settings
- transponder redundancy provisioning.

The more important features of the system design, as embodied in the RFT, are summarised at Figure 15 and discussed below.

10.1 SPACECRAFT SIZE

During the design process, a Delta-class spacecraft was identified as having two significant advantages:

- there was substantial industry experience in the design and production of satellites in this class;
- maximum flexibility of choice of launch vehicle (Shuttle, Ariane or Delta) would be preserved, noting particularly the uncertainty then surrounding the development of the Shuttle and Ariane programs.

Following considerable consultation with the potential spacecraft tenderers, the RFT was structured such as to:

- require compatibility with the Shuttle/PAM-D and Ariane 3 SYLDA launch vehicles;

- seek comment from tenderers on any consequences (technical, cost, schedule, etc.) of also providing compatibility with the Delta launch vehicle.

Earnest payments have been made to NASA and Arianespace to secure launch slots on all three launch vehicles.

10.2 CHOICE OF FREQUENCIES

The system design is based on operation at the following frequencies:

- uplink 14.0 - 14.5 GHz
- downlink 12.25 - 12.75 GHz

Two factors led to this requirement.

The desire for maximum freedom of locating earth stations, particularly in city environments, led to a conclusion that the 6/4 GHz band should be avoided, since the use of 4 GHz microwave systems in the Australian terrestrial network is widespread and growing.

Secondly, the HABCSS service is essentially a broadcasting service, and no BSS frequency allocation is made in the 4 GHz band in Region 3, whereas a shared FSS/BSS allocation is available in the 12 GHz band in that region - see Figure 16.

10.3 ORBITAL LOCATION

The orbital locations chosen are 156°E, 160°E and 164°E.

The need to maximise flux density in western parts of Australia, particularly for the HABCSS service, led to this conclusion, with Figure 17 illustrating views of Australia from a number of locations. The gain in eirp in Western Australia for a location at 160°E compared to 128°E is in the order of 1.3 dB in clear sky conditions.

On the other hand, locations further to the east were judged to be not acceptable due to the lower earth station elevation angles which would apply under these conditions - e.g. the elevation angle from Perth for a 160°E location is about 30°.

10.4 SATELLITE FOOTPRINT

The satellite design for the downlink calls for:

- a national footprint, as illustrated at Figure 18
- four spot beam footprints, as illustrated at Figure 19
- a PNG spot beam, as illustrated at Figure 20.

In the uplink direction, the design calls for a national footprint, including PNG, or two separate footprints, one national and one equivalent to the PNG downlink spot.

The four spot beams provide a practical compromise between a desire to provide five or more footprints to meet the ABC requirement for State-oriented distribution of programs, and the need to work within feasible mass/power limits for a Delta class spacecraft.

The definition of the HACBSS earth station antenna diameter as being 1.2 - 1.5 metres led to the conclusion that an eirp of 47 dBW was required, and this is specified in the RFT for each of the four spot beams. The expectation was that tenderers would meet the requirement with TWTs of about 30 watts output power. Within each spot beam, zones of expected lower earth station population were identified, with the eirp requirements of not less than 42dBW being required in these zones; the purpose of this relaxation was to ease the spacecraft power requirement.

10.5 SATELLITE CAPACITY

The RFT specifies a requirement for 15 transponders per spacecraft, each of bandwidth 45 MHz, in a frequency re-use linear polarised arrangement - see Figure 21. Four high powered TWTs (approximately 30 W) and eleven low powered TWTs (approximately 10-15W) were specified. System performance was defined in terms of eirp in each beam (spot beams 47 dBW, national beam 36 dBW).

It may be seen that the HACBSS power requirements (120W) constituted a substantial percentage of the overall power requirements (230-285W).

10.6 ECLIPSE CAPABILITY

Battery capacity providing full eclipse capability was specified.

10.7 SATELLITE MONITORING AND CONTROL ARRANGEMENTS

The proposed arrangements for the Satellite Control and Operations Centre for the provision of earth stations for Tracking, Telemetry, Command and Monitoring are illustrated at Figure 22.

10.8 EARTH STATIONS

Six classes of Government owned earth stations were included in the system design, namely:

- Major City Earth Stations (MCES), to provide transmission capacity to meet the ABC requirements described earlier, to provide the main exchange end of the Telecom remote telephony service, and also to provide a

means of aggregating the requirements of those private users who choose not to provide their own earth stations - ten such earth stations were identified, four potentially with dual antennas.

- Telecom earth stations for the remote telephony service.
- Department of Transport earth stations.
- Earth stations for the reception of programs at ABC regional transmitters.
- HACBSS earth stations - a small number of units was identified as being required for test purposes, to enable the Department of Communications to establish suitable standards for units to be purchased by the consumer.
- Minor Earth Stations (MES) were identified as being required by private organisations for the establishment of private telecommunications networks (e.g. mining companies, police, education authorities); accordingly, a small number was identified for purchase, primarily for demonstration purposes in due course.

11. TENDERING PROCESS

The Request for Tender issued on 30 October 1980 was a major document some 2200 pages in length and weighing some 11 kg. The document was issued by OTC(A) on behalf of a number of Government organisations, and called tenders for supply of:

- three spacecraft, with options for purchase of a fourth and fifth spacecraft;
- two TTC&M earth stations and a Satellite Control and Operations Centre (the RFT clearly identified an intention to purchase these items from the spacecraft contractor);
- Major City Earth Stations - fourteen antennas at ten locations, with G/T in the range 33-39 dB/K;
- Telecom earth stations for the remote telephony service, together with appropriate switching equipment - prices were sought for quantities ranging up to 500 annually;
- Telecom transportable earth stations, of capacity up to 12 circuits, to aid early restoration of communications in catastrophic circumstances; quantities sought were in the range 1-5 units;
- Telecom large transportable earth stations, of capacity in the order of 300 circuits, to provide a means of filling gaps in communications capability between large centres due to delays in terrestrial works programs;

- Department of Transport earth stations, with quantities sought being in ranges up to and exceeding 100 units;
- ABC regional television and sound receive only earth stations for a variety of performance requirements (G/T in the range 22-34 dB/K) and quantities up to 50 units annually;
- HACBSS earth stations for a variety of performance requirements (G/T in the range 14-22 dB/K) and in quantities up to 40 units;
- Minor Earth Stations for a variety of performance requirements (G/T in the range 22-26 dB/K) and in quantities up to 20 units.

12. SYSTEM OWNERSHIP

As indicated earlier, the Government decided in October 1979 to permit users to own earth stations. The arrangements for ownership of the space segment and the Major City Earth Stations have developed over a longer period.

When the Government announced in October 1979 its decision in principle to proceed with an Australian National Satellite System, no decision had been made regarding system ownership, and the Satellite Project Office was established within the then Postal and Telecommunications Department (now Department of Communications). The majority of the personnel associated with the system design were seconded to the Department from OTC.

In September, 1980, the Government made two major decisions, namely:

- to agree to the release of the RFT, formally calling tenders for the system;
- to nominate OTC(A) as the interim owner of the system, pending further consideration of the options.

Late in October 1981 the Government announced a decision to establish a proprietary company, AUSSAT Pty Ltd, to own and manage the system. The company is to be 100% Government-owned initially, with an expressed intention that 49% of the equity would be divested to the private sector in due course (probably during 1982) by means of stock exchange listing.

Arrangements such as those outlined above will create a precedent in Australia, for a number of reasons. Firstly, communications has been a Government monopoly, as it is in most countries of the world. Secondly, while Government/private companies do exist in some industries in Australia (the tourist industry is one example) the shares in those companies have not been publicly listed.

13. SUMMARY

Australia is a country well suited to take advantage of the capability of a modern satellite communications system. The geography and demography of Australia is particularly relevant in this respect, and current indications are that the prime uses to which the system will be put will include

- the provision of telecommunications and broadcast services to remote communities
- the distribution of broadcast services, particularly television
- the provision of telecommunications services to the business community.

The system design, offering 11 low powered and 4 high powered transponders operating in the 14/12 GHz band, has been heavily tailored to meet Australia's unique and particular requirements and provides a demanding challenge to spacecraft designers, particularly in respect of the antenna design.

Future
Telecommunications
Systems and
Services:
Technical
Considerations

Towards 2000 - The Next Two Decades in Data Communications

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1. Abstract

The paper presents a brief survey of the State-of-the Art in Data Communications and discusses the possible trends in the development of data networks in the next two decades. The discussion is based on the past evolution in telecommunications and computer technology which resulted in the unprecedented rate of growth of new and improved telecommunication services, new concepts in data networks and new equipment.

2. INTRODUCTION

The aim of the paper is to present the state-of-the-art in Communications and Computers, and to speculate on the trends in the developments in Data Communications in the next two decades. The task undertaken is not an easy one, and in the opinion of the author of this paper, the predictions can be hardly successful because the progress in technological advances, and hence the rate of growth of new concepts, demands for new services, developments in microelectronics, transmission systems etc, which have happened just only over the last two decades, is difficult to encompass in a single and coherent presentation.

Data Communications evolved as a result of a convergence of two technologies, those of computers and telecommunications, and since the late 50s we have been witnessing the emergence of systems which combined them both. In the early stages of development the systems were referred to as teleprocessing systems and at present are generally known as data communications systems.

The discussion on the evolution of Data Communications has to include the developments in three very broad areas, namely

- evolution of computer systems
- evolution of computer networks
- the developments in telecommunications (Fig.1)

The technological and technical progress in each of the above mentioned areas depends greatly on economical, political, national and world-wide situation, therefore any prediction is subject to unexpected and possibly abrupt changes due to worldwide energy crisis, wars, diplomatic relations between nations etc.

Also we should not fail to acknowledge the significance of the impact of advances in technology on society. The acceptance and

familiarity with new technologies by society at large may change the pace of expected rate of growth by demands of new, not yet defined services, or by rejection of some of the benefits (or menace?) resulting from this revolution in microelectronics, satellite communications, information transfer etc.

A synergistic interaction of all these factors is too complex to be fully over-viewed, but some conclusions drawn by reviewing the past history of the revolution in computers and communications may become a base for qualitative speculations on possible trends and changes that might be expected in the next two decades.

3. EVOLUTION OF COMPUTER SYSTEMS

In our review of the evolution of computer systems we could easily go through the fascinating history of calculating devices such as abacus calculating rods, analytical machine, but we would rather concentrate on the developments which had taken place in digital electronic computer systems. In the early days of digital computer (just only forty years ago) an information in digital form was stored on cards, (punched cards have been with us since 1899), or on paper tapes and these two were used as the input to or output from a computer. The actual input/output devices (readers, punches) were connected directly to the computer. Towards the end of 1950s the concept of time-sharing systems was formulated and in the early 1960s the experimental time-sharing system in Masachusset Institute of Technology, was implemented. Since then the progress in software and hardware for computer systems has been remarkably fast. The operating systems and new languages designed for on-line systems to allow for conversational mode for man-machine interaction and for real-time systems for process control have generated new perspectives for computer applications, demands for new equipment (terminals, storage, controllers), and

also demands for standardisation and new skills and expertise (computer operators, programmers systems analysts etc.)

The exchange of information between computer and terminals in remote locations took place in 1960s and it gave a start to a new era of computer networks.

4. DEVELOPMENT OF COMPUTER NETWORKS

During the past two decades communications between remote terminals and a computer, as well as the communications between computers was mainly based on the existing telex and telephone networks. The early sixties were marked by the development of centralized networks connecting a number of terminals to a single computer in a point-to-point, or multipoint network configuration based on leased telephone lines. In order to improve utilisation of communication lines and to decrease the cost of networking, the techniques of multiplexing and concentrating were introduced, which allowed for sharing a single transmission medium by a number of terminals of the same or different transmission characteristics (transmission codes, speeds, interfacing). These concepts led to the simple network structures presented in Fig. 2.

In these early networks the analog systems were used for data transmission, and as a consequence a flurry of devices (modems, acoustic couplers) converting digital signal into signals compatible with transmission characteristics of voice telecommunication lines, have been designed.

However, the intrinsic characteristics of voice frequency lines and the equipment of telephone exchanges imposed serious limitations to the speed of data transmission and a high degree of dependence on common telephone carriers, tariffs and standards. The transmission speed of data over voice frequency lines is limited to 4800 bits/sec on unconditioned switched lines (in many countries it cannot exceed 2400 bits/sec) and to 9600 bits/sec on privately leased lines.

Towards an end of sixties an urgent need for access to the distributed data bases and different processing services, residing in geographically scattered computers, led to the computer-computer, networks in which a number of computers are interconnected forming a distributed network. The topologies of computer networks are shown in Fig. 3. Computers in these networks (nodes) may perform different processing functions and also some of them may be used as nodes in transport networks

performing switching, routing, flow and error control and some other functions different from actual processing of information (Fig.4). This type of topology is implemented in many networks examples of which are ARPANET, TRANSPAC, DATAPAC.

Switching may generally be based on two techniques:

- circuit switching
- and - store-and-forward technique

The former is performed by the establishment of a physical path between two points of a network before the actual exchange of information takes place, in the latter an information is accepted and stored in a switching node and routed to the next as soon as the optimal path is available. The two methods which fall under this category are message-and packet-switching.

Each method requires different communication protocols and network management procedures, hence different software and supporting hardware equipment. The store-and-forward feature of message-and packet-switching technique has a number of advantages as compared to circuit-switching. They may be summarised as follows:-

- A message/packet input from one data terminal equipment (DTE) can be broadcast to a number of other DTEs;
- A message is accepted by a switching/transport system irrespective of whether the addressed station is available or not at that time;
- Data switching nodes can perform many functions like: error detection and correction, editing, message duplication, message protection, code and speed conversion, handling of different communication protocols, flow control and routing, monitoring the network's status etc.

In addition to the above advantages packet-switching offers shorter network transit delays and more efficient channel utilisation for bursty, low and moderate data transfer throughput which makes this technique more appropriate for interactive real-time applications than message switching systems.

5. THE DIGITAL COMMUNICATION NETWORK

The telecommunication networks which evolved from the needs to transmit speech has been undergoing the "digital revolution" since 1970. The driving forces behind this rapid changes in telecommunications

are the advances of LSI and VLSI digital circuit technology and the evolution of computer networks. The fast growth in data traffic and an increasing number of new services being introduced or being planned have accelerated the implementation of new forms of switching and transmission, turning the current telecommunication network away from its evolutionary course as an analog frequency division multiplexed and space division switched networks towards an integrated voice and data network.

The French E10 system designed at the Centre National d'Etudes des Telecommunication in the late 1960 was introduced in 1970 followed shortly by E12 and MT20. The US No.4 ESS was introduced in 1976, the first Swedish AXE 10 in 1977, the Italian PROTEO system has been operational since 1979 and Germany has a digital version of the previous semielectronic system of 1977 EWS. The ITT's System 12, a subsystem of the future Network 2000 and the System X, the result of the combined efforts of the British Post Office, GEC Telecommunications, Plessey Telecommunications Systems and Standard Telephone and Cables show that digital switching is progressing fast and everywhere.

The future Integrated Services Digital Networks, ISDN, offer the opportunities to introduce new services which would otherwise not be possible due to constraints of the public switched telephone networks (p.s.t.n), principally due to its 4 kHz bandwidth and its restricted signalling capability. The growth of services in the past and in the future as presented by R. Daniel in his paper on Future Developments of Telecommunication Networks is presented in Fig. 5.

6. THE NEW AND ENHANCED SERVICES

6.1. FACSIMILE

A well known type of service offering a transmission over long distances of written information (letters, weather maps, newspaper pictures) in its original form known as facsimile has been enjoying its revival during the last decade. Invented in 1842 it had not been marked by high rate of general interest for many years mainly due to its relatively low distribution. An interesting study of the relative cost of sending documented information by mail, courier service and facsimile conducted by the Australian Telecom (AUSTDATA) show [Table 1] that facsimile costs lie between those of mail and the courier service but the speed, security

and conservation of resources lie with facsimile [Telecom 2000]

Type of Service	Approximate Cost	Delivery Time per Message
Mail	\$ 2.00	1 - 2 days
Courier Service	\$53.00	1 hr. (minimum)
Facsimile	\$16.00	10 minutes
The approximate cost and delivery time of a document consisting of 10 pages sent across an urban centre (approx. 15 km)		

Table 1

From the same study the comparisons of speeds and costs in different facsimile technologies are presented in Fig.6. This report, TELECOM 2000, investigates also the demands for facsimile services till the year 2000 and predicts the likely growth of facsimile could vary from 600000 units to 1.3 million units in the year 2000.

Quoting from the TELECOM 2000:
"Possible events supporting the upper forecast limit include:

- technological developments and economies of scale could reduce equipment cost by an order of magnitude over the next 25 years;
- an increase in the business use of facsimile at a rate such that the proportion of business telephone services having a facsimile unit reaches 50% by 2000;
- the introduction of decentralized offices, or more of the community working at home, the penetration of facsimile services into domestic and domestic - business communication relationships may increase until by 2000 there is about one facsimile unit for every 25 domestic telephones;
- agreement on international standards;
- growth of in-house facsimile networks which may create demand for inter-connection between these networks, and generate new uses and new markets".

Estimates of the number of facsimile units in USA for 1979 varied between 100,000 and 200,000 and numbers between 270,000 and 500,000 were expected for the year 1985; the number of facsimile units in Japan and Europe were then estimated to be around 80,000 and 15,000 respectively. Recently the private facsimile networks started to

proliferate in USA, the examples are: a network for Provident Life and Accident Insurance Company with headquarter office in Chatanoga Tennese, DETROITbank's Personal Loan Department Network and a high-speed digital facsimile network linking UNARCO Commercial Products facilities nationwide. According to the recent publications [Bennet, 1981] there are currently 20 competing manufacturers and 70 different product types offering analog, digital and hybrid switching equipment with transmission speeds for a page of text (approx. 2000 characters) from 6 minutes to 20 seconds.

In 1979, the German PTT introduced Telefax service with facsimile devices conforming to CCITT group 2 recommendations (analog, 3 minute transmission), and recently incorporated into the network units of CCITT group 3 recommendations i.e. digital with speed of 1 minute. Currently a new generation of facsimile machines from the group of "subminute terminals" is a subject of CCITT group 4 recommendations. This generation will be suitable for use in computer networks as input/output terminals compatible with high speed networks using HDLC (High-level Data Link Control) protocol. A comparison of the typical cost of telex, communication teletypewriter and facsimile is shown in Fig.7.

6.2. ELECTRONIC MAIL

The new applications of facsimile is in an electronic message service, known as an electronic mail. A simple model of an electronic mail system will consist of facsimile input, a transmitting terminal, a communication channel and facsimile output. The facsimile units generating messages may be connected to the transmitting terminal via dial-up or dedicated lines. The messages entering the transmitting terminal can be stored and switched to the receiving terminal.

Generally, electronic mail system have been classified according to the following parameters:

1. Speed - transmission of a complete A4 document:
 - Group 1-4 to 6 minutes,
 - Group 2-2 to 3 minutes,
 - Group 3-30 - 60 seconds for data rate of 4800 bits/sec,
 - Group 4 - Subminute group for data rate at 9600 bits/sec.
2. Types of Facsimile Input and Output:

- Generation 1 - Mail is electronically transmitted only between postal offices,
- Generation 2 - Systems accept electronic mail inputs but retains the physical mail delivery,
- Generation 3 - Systems accept both electronic inputs and outputs from business-to-business and home-to-home connections;

3. Type of User:

Public or private;

4. System characteristics:

The distant terminals can serve as a remote reproduction machines connected either point-to-point or through store and-forward network;

5. Mode of Transmission:

Analog or digital;

6. Communication Channel:

The channel can operate in either the circuit or packet switching mode.

6.2.1 ELECTRONIC MAIL SYSTEMS

The U.S. Postal service has been experimenting with an international electronic message system since July, 1979. The system known as INTELPOST operates in a store-and-forward mode.

The German PTT (The Deutsche Bundespost-DBP) introduced the Telefax network and plans the operation of an upgraded electronic mail system which will ensure the delivery of paper mail in one day between any two points in the country.

Generally, it is envisaged that by 1990 half of U.S. mail services could be handled by the electronic mail systems [Bennet, 1981]

6.3 TELETEXT AND VIEWDATA

The new services which are already offered in some countries and planned in many others are services which belong to the group of systems with 'soft copy output', namely Teletext and Viewdata.

The BBC Ceefax or ITV Oracle services (technically almost identical), the French Antiope, and German Videotext are all based on the concept of transmitting a text within the blank lines of the TV signal, and requires relatively non-expensive attachment to a commercially available

ble TV set.

The Viewdata system makes use of the telephone network for text transmission. A user would simply dial the number of a service and would be connected to a computer system which then would transmit data of a selected page along the phone line.

The existing Viewdata systems are:

Prestel in Britain, Telidon in Canada, Bildschirmtext in Germany and Teletel in France.

The telecommunication services which could be offered by use of a TV set with attachments are summarized in Table 2, and the example of typical features of Teletext and Viewdata, based on Germany Videotext and Bildschirmtext are depicted in Table 3.

7. WIDEBAND CHANNELS FOR DIGITAL DATA TRANSMISSION

The new data communication systems fall under three categories:

- satellite end-to-end systems such as SBS, Advanced Westar and AT&T Scanning Beam System;
- Microwave packet service such as XTEN;
- Packet - switching with conventional distribution facilities such as ACS.

The general discussion on a new generation of digital data transmission system therefore, must include some aspects of advanced digital communication satellites and microwave terrestrial systems.

An international experiment in high-speed computer networking via satellite (Symphonie) which began in 1977 and ended in 1979, conducted jointly by IBM System Communications Division, Comsat Laboratories, the French Postal and Telephone Ministry, the German Aerospace Research Establishment (DFVLR) and the Deutsche Bundespost led to some design specifications of SBS and Telecom 1.

SBS - Satellite Business system provide switched communication network for integrated voice, data, facsimile and teleconferencing. The system utilizes 12/14 GHz frequency and operates in a time-division multiple access (TDMA) mode. The antenna diameter is 5.5m (roof mounted) or 7.7m (ground mounted), located on customers' premises.

Telecom 1 [Prospace] will be France's first national telecommunication satellite fully designed and built by the French company MATRA, a member of the MESH Consortium. MESH Consortium was formed in 1969 as a means of combining the capabilities of Europe's leading aerospace companies.

It is envisaged that Telecom 1 will be in operation by July 1983. It will enable the French PTT to offer a wide range of new communication services including: data transfer between computers, video-conferencing, video transmission, facsimile, electronic mail etc. One of the most novel systems is a system planned by Xerox Telecommunications XTEN which will provide high-speed, end-to-end digital communication throughout the USA [Kaplan, 1979].

The long distance connections will be provided by a leased satellite transponder and signals from the satellite will be relayed to ground stations and from there to local nodes via microwaves. Local nodes will be able to communicate with one another. Small roof antennas (0.6 to 1.2m) on the users' premises within 9.6km from the local nodes could communicate with these nodes.

The services offered include store-and-forward message transmission, conversion for incompatible terminals, priority control, message retrieval, teleconferencing, site-to-site digital service for interactive remote job entry and computer-to-computer applications.

The AT&T plans to offer Advanced Communications Service, ACS, in the near future as an intelligent data network connecting different types of computer terminals throughout US. The network will be a significant addition to existing packet-and message-switching networks and will offer three types of services.

- packet switching for bulk transmission and interactive use,
- message switching with various priority levels,
- simple facilities for the preparation, editing and validation of messages [Kaplan 1979]. Terminals will handle data at 9.6 Kbits/sec and computer and intelligent terminals will transfer data at 56 Kbits/sec. The ACS will also be able to interconnect private subnetworks and public networks.

Thomas Mandey in his paper "Assesing the New Services" in November 1979 issue of IEEE Spectrum stated that "In order to take full advantage of the new communication services, the option of wideband digital distribution to individual desks will be a necessity. New PABXs will provide this facility in the early 1980... Looking further to the late 1980s one sees the option of a digital telephone termination for general public use. In fact, distinction between voice and data networks will gradually disappear."

One of the recent developments technologies of transmission media which has made a tremendous impact on the wideband digital distribution systems are the fibre-optics systems.

The first operational fibre-optics system was introduced in USA only just in April 1977 by General Telephone of California, in Japan at the end of 1976 by Yokosuka Electrical Communication Laboratory (ECL), in UK in May 1977 by British Post Office. Since then many more systems have been installed and they have proven to be an economic alternative to wire cables [Mokhoff, 1981]. According to predictions of Gnostic Concepts Inc. in 1978 (a market forecasting company) within the next decade worldwide sales of optical fibre assemblies for communications systems will increase annually at an average of 50% from 1978-1985 and at 20% from 1985-1990 [Table 4]

	1978	1985	1990
	million of dollars		
United States	21	350	889
Canada	6	40	85
Japan	2	91	333
Europe	10	178	462
Total	39	659	1770

Table 4

The very same company predicted in January 1981 that the fibre-optics market is expected to grow from \$145 millions to \$3500 millions by 1990 for the USA alone.

AT&T plans to install an international link on the bottom of the Atlantic from the US to Europe (~ 6500 km) whose cost will be by two-third less than present undersea wire-cable link. The French PTT is planning to install commercial links in the Atlantic and the Mediterranean by 1985 [Mokhoff, 1981]. The new systems offer increasing capacities with longer repeaterless distances.

One of the new-systems in the USA is an 8.6 km repeaterless trunk cable for the Central Telephone Co. in Humble, Texas which at its full capacity in 1984 will carry 9408 simultaneous voice channels at a 90 Mbits/sec rate. The longest repeaterless span of 52.6 km at 100 Mbits/sec was achieved by Nippon Telegraph and Telephone (NTT) at the end of 1978. Currently efforts are being directed to the development of long-haul, large-capacity systems.

The systems of rates at 1.544 Mbits/sec have already passed field trials (Japan and Germany)

In the fusion of telecommunications and computer technology two developments were of particular importance:

- a) digitalization and
- b) wideband transmission media.

The rate of growth of digitalized switching systems for voice and data, digitalized end-user equipment and transmission systems have been accelerated by the recent developments in semiconductor technology.

Increasing packing densities allows for more complex circuits to be integrated into a single chip. It is expected for example that the SLIC (Subscriber Loop Interface Circuit) for interfacing with the telephone digital switched network will be soon available on one chip and fully digital codecs will appear during the next five years [Mokhoff, 1981]. Since the price per gate (or bit) has decreased a hundredfold over the last 20 years and will be decreasing further, the cost per circuit line for digital switching will be reduced below that of analog switching quite substantially.

The wideband communication channels, the cost of which is generally independent of the distance between the terminals, are provided by the communication satellites. The capacity of communication satellites has increased from 240 voice channels or one TV channel (Intelsat I) to 12500 voice channels and 2 TV channels (Intelsat V) while the cost per voice channel has decreased approximately 40 times [Abramson, 1980].

By 1990s still higher capacity satellites using 20 and 30 GHz bands may be in operation. The on-board switching, multiple beams and intersatellite links will further increase the capacity and connecti-

vity.

The future terrestrial switched public broadband networks will be probably based on fibre-optic transmission systems and the future Integrated Services Digital Networks, domestic and international will bring the realization of all new services like videoconferencing, electronic mail, direct broadcasting, viewdata etc. to our homes and offices. These type of services will provide a cost-effective means of communications substituting business travels, whose costs due to acute energy crisis may soon become prohibitive. The easy fast, secure and reliable information transfer should assist mankind in intellectual developments as well as growth of wealth and security. However, these prospects are alarming as well as being exciting. Let us quote the speculations of D.W. Davies on the impact of information revolution on society.

"The exciting possibility is that more and better classified and presented information will be available to decision makers and that groups of decision makers may interact closely in solving complex problems. The alarming aspects arise from the danger of uniformity... Stereo-type forms of procedures and standardized ways of structuring data of all kinds, are gradually moulding the world to be uniform and commonplace. When taken to an extreme this process will remove the variety and adaptability, necessary for satisfactory evolution in the face of the changing society".

Will this revolution bring us a realization of the dreams of Utopians or the nightmares of Orwellian Society? - asks Douglas F. Parkell in his guest editorial in Communications, 1981. This question should not remain unanswered but who will take the responsibility of answering it?

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Type of communication	In existing networks		In future broadband-cable communication networks		
	TV-distribution networks (data in TV-signal)	Switched telephone network	Without return channel	With return channel	With return channel and central exchange
Text	Video text	View data (Bildsch. text)	Cable text	Cable text retrieval	Individual cable text
Still picture	Video Still picture	Slow-scan TV	cable picture	cable picture retrieval	Individual cable picture

TABLE 2
Telecommunication Services Realizable by TV Sets with Attachments [Kaiser]

Form of telecommunication	Principle of transmission	Transmission speed	Average waiting time for text page	Text volume	Selection of wanted text page
Video text (VT)	Embedded in TV-signal	Max. 9Kbit/s per TV-line	12 sec for following volume	4 magazines of 100 pages each in 8 line pairs	Out of cyclically transmitted text
Bildschirm-text (BT)	Via data modems in telephone network	Forward: 1200 bit/s reverse: 75 bit/s	5-6 sec	Practically unlimited	Search in dialogue with text center

TABLE 3
Typical Features of VIDEOTEXT and BILDSCHIRMTEXT [Kaiser]

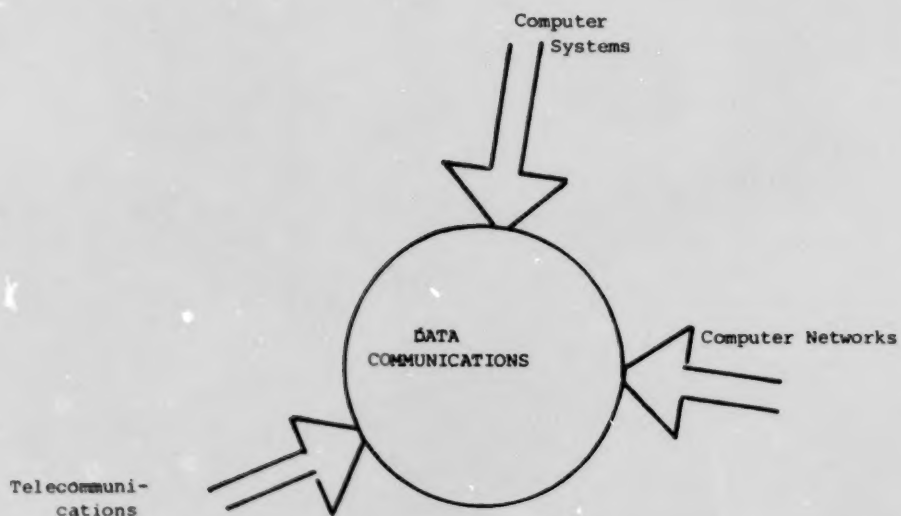


Fig.1 Data Communications as a synergy of computer systems, computer networks and telecommunications/

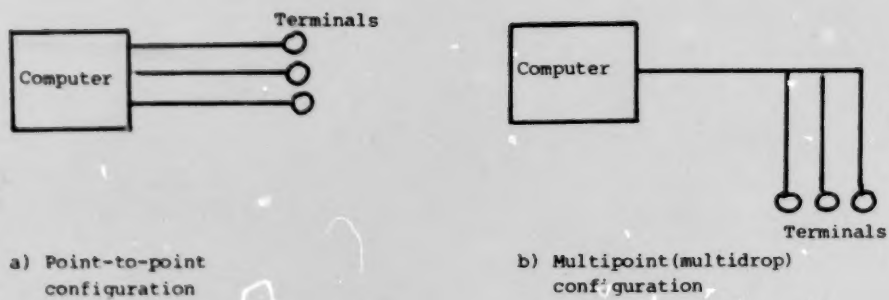


Fig.2 Simple network structures

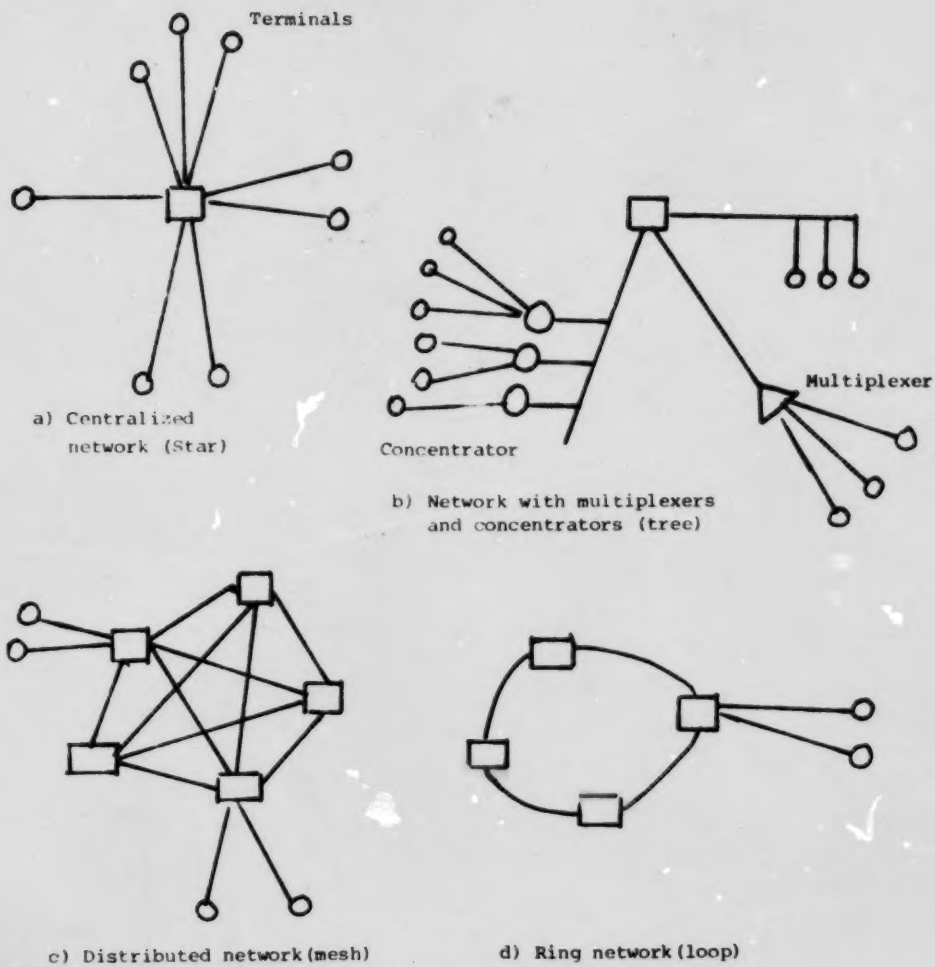


Fig.3. Topologies of computer networks

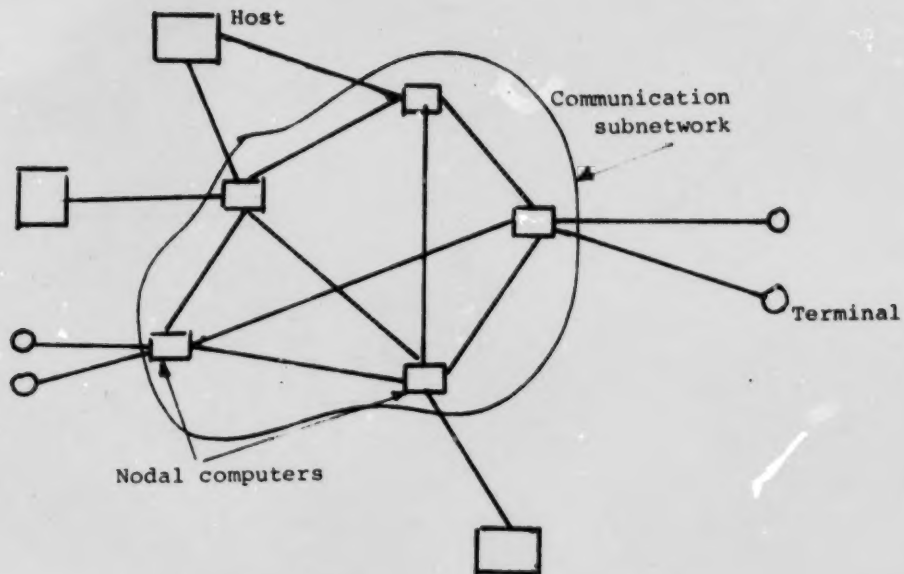


Fig.4. Communication Subnetwork

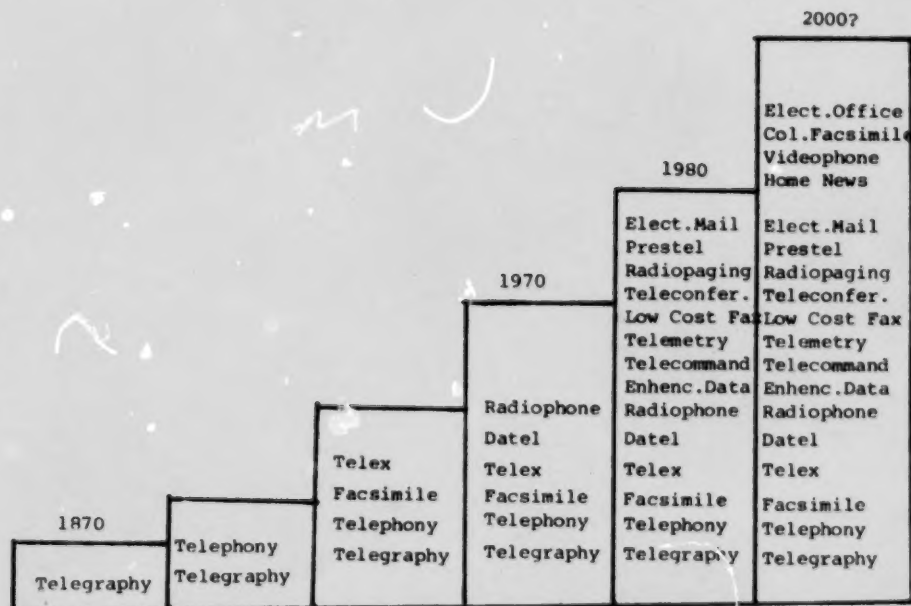
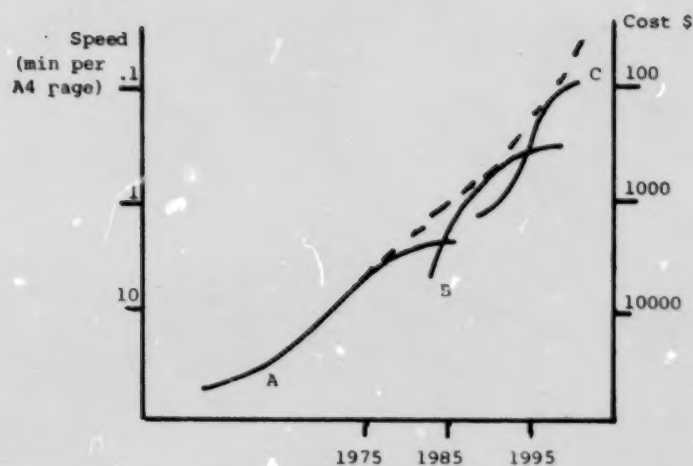


Fig.5. Growth in Services [Daniel]



A - Analogue encoding and transmission
Wet - image printing

B - Digital encoding
- Analogue transmission
- Dry - image printing

C - Digital encoding and transmission
High-speed printing
Direct - interface with computer

Fig.6. Facsimile speed and cost for different technologies [Telecom 2000]

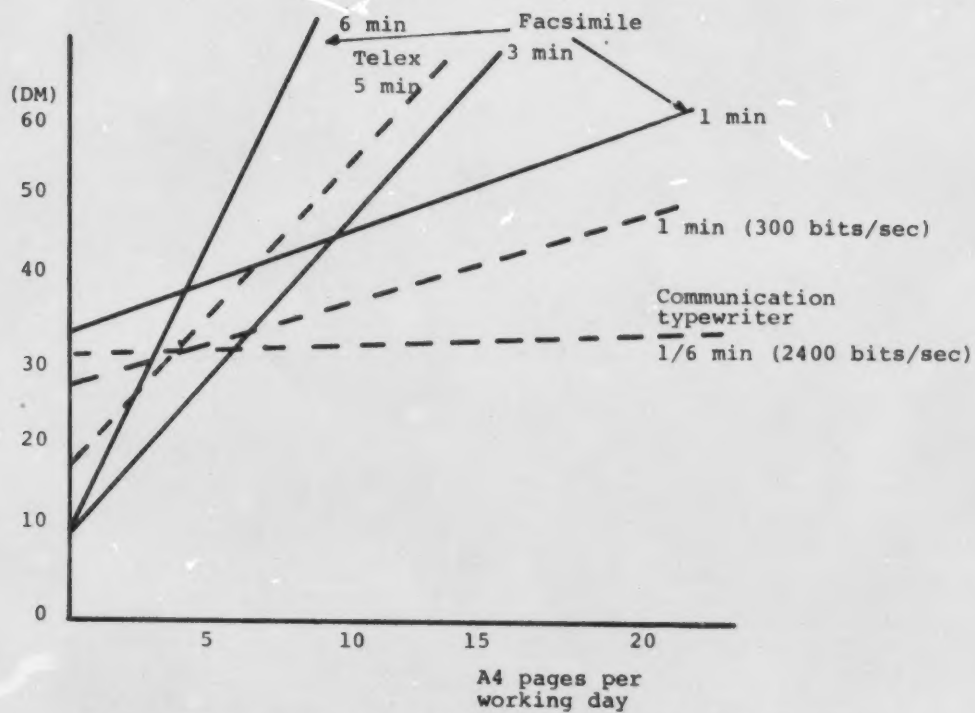


Fig.7. Cost comparison between Telex, communication typewriter, and facsimile (Kaiser)

AN APPROACH TOWARD AN INTELLIGENT TELEPHONE NETWORK

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ABSTRACT

While the network only gradually evolves to an ISDN, the demands for enhanced telephone services and data, facsimile, video and other non-voice services are growing rapidly. This paper identifies the network functions required by such services and shows that concentration of these functions in transit exchanges permits economical provision of such services from the time when the telephone network is still mostly analog. The paper also discusses further network development stages.

1. INTRODUCTION

Stored program controlled switching systems and common channel signaling systems have been introduced to economize and functionally enhance the telephone network. The telecommunication network is now being increasingly digitalized to reduce network cost and permit provision of various non-voice services. All these efforts lead to what has become a global trend - an integrated services digital network (ISDN). Along these lines, NTT envisages a new network concept called an INS (Information Network System) (1), (2). However, it would probably be the 21st century when this concept fully materializes. At least for another decade, the existing analog telephone network will continue to be the major part of the network. As an economical means of providing both enhanced telephone and non-voice services, even during the transitional period to an ISDN, this paper describes a new service control (NSC) system, where enhanced functions required for providing new services are concentrated. It also takes an intelligent telephone as an example to show its actual application in the telephone network. It finally discusses its development in the context of the network development stages (3).

2. NEW SERVICE CONTROL SYSTEM

The functions performed by a telecommunication network can be classified into three levels according to the degree of information processing involved.

Switching and transfer function: transparent transfer of information.

Communication processing function: processing of information without changing its meaning, eg. storage, protocol conversion.

Information processing function: processing of the meaning and content of information.

Extended switching functions, communication processing and information processing are necessary for providing enhanced telephone and non-voice services. If the traffic that requires such functions is limited, these functions can be concentrated on certain parts of the network for efficient use of facilities. The New Service Control (NSC) system performs additional switching

functions specific to new services and interface functions between switching nodes and communication or information processing nodes. Such switching functions include new service identification, new service subscriber data management, and new service charging control. This system need not be an independent system, but can be realized by equipping some transit exchanges in the telephone network with the above functions. By doing so, common use of facilities and centralized administration of services can be expected and new services can be provided quickly and economically on a nation-wide basis with little need for upgrading existing local switches (4). Figure 1 shows the basic concept of this system. Figure 2 shows its implementation in the Japanese network. It is desirable in this network configuration that the higher the traffic density of a particular service, the lower in the network hierarchy the NSC system should be located.

The following are representative services which can be provided by the NSC system alone or in conjunction with communication processing nodes and information processing nodes.

Telephone services: telephone conference service, credit card charging service, voice storage service, superbelt service (pocket belt service with capability to identify the caller).

Non-voice services: Data communication service by an intelligent telephone, facsimile communication service with storage and compression functions, videotex, teletex data base service (5).

The following section takes a data communication service with an intelligent telephone as an example of the NSC system application.

3. INTELLIGENT TELEPHONE SERVICES

An intelligent telephone is a push-button telephone with a simple keyboard and printer or a display to permit simple data communication, originating subscriber display and other new services. The intelligent telephone developed by NTT is called a data telephone and is shown in Fig. 3.

The following example focuses on data communication (6), (7). These services include order

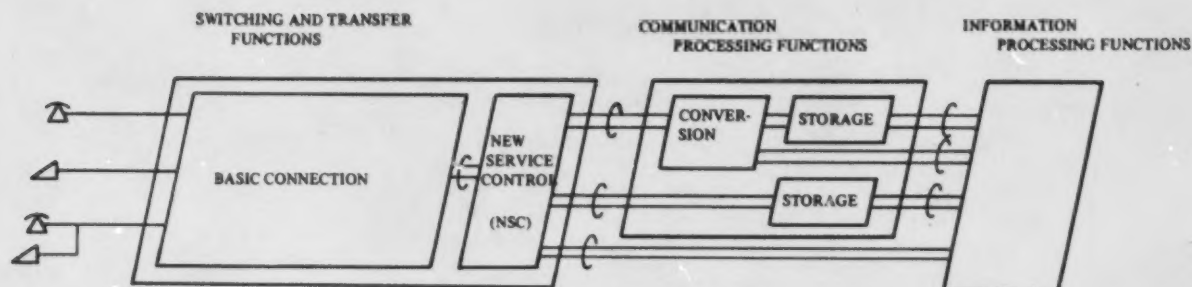


FIGURE 1 BASIC CONCEPT OF THE NEW SERVICE CONTROL SYSTEM

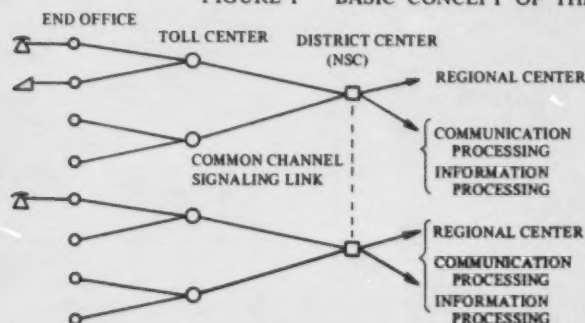


FIGURE 2 NETWORK CONFIGURATION EXAMPLE



FIGURE 3 DATA TELEPHONE SET
EXTERNAL VIEW

entry service, credit card check service, seat reservation service and savings balance investigation service. These may be provided either end-to-end or end-to-center, but the latter would be dominant. Assuming end-to-center connection, the main switching functions required for the services include terminal-to-center link control and terminal control (call termination without ringing, sending/receiving mode switch), and main communication processing functions include protocol conversion and data-to-voice media conversion.

3.1 NETWORK CONFIGURATION

The possibilities as to where in the network the above functions in Pattern 1 are provided can be roughly classified into the three patterns shown in Fig. 4.

Pattern 1: New service functions are provided at each center and the telephone network performs the normal call processing function alone. Since the facilities for executing new service functions are decentralized, they are used at low efficiency. In the case data communication speed is low, the transit lines are also used at low efficiency in terms of transmission speed capability.

Pattern 2: Facilities for new service functions are centralized at certain transit exchanges, i.e. NSC systems, in the telephone network and shared by a number of centers. So, they are used efficiently. In the case that the data communication speed is low, the same inefficiency as in Pattern 1 results.

Pattern 3: New service functions are centralized as in Pattern 2. The centers are connected via a packet switched data network to those NSC transit exchanges closer to the subscribers who receive the new services. Thanks to this packet

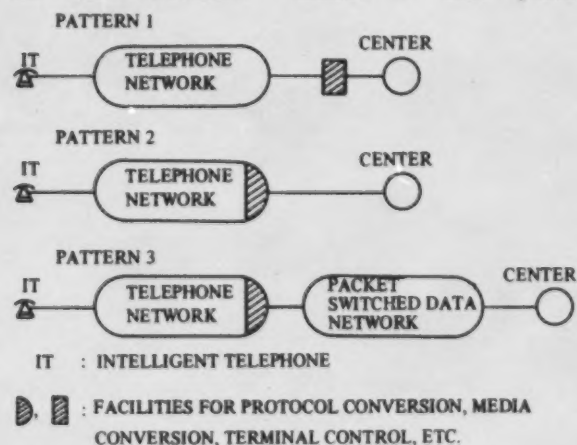


FIGURE 4 CONNECTION PATTERNS AMONG AN INTELLIGENT TELEPHONE, THE NETWORK AND A CENTER

Thus, Pattern 3 is the optimal configuration.

3.2 PROTOCOL STRUCTURE

The protocol of simple data communication for intelligent telephones should be as universal as possible in order to facilitate incorporation of various, future intelligent terminals. The following protocol structure is chosen with this principle in mind.

- 1) The protocol between intelligent telephones and the NSC system and that between the NSC system and the center are separated.
- 2) The call set-up protocol between intelligent telephones and the NSC system is made the same as the existing telephone signaling system to avoid any modification to the latter.
- 3) Considering that the intelligent telephone is simpler than an ordinary data terminal and that it uses push-button signal instead of frequency shift signal for data transmission, the protocols X.28D, X.3D and X.29D are derived from X.28, X.3 and X.29 for interfaces shown in Fig. 5.

A typical communication sequence is shown in Fig. 6.

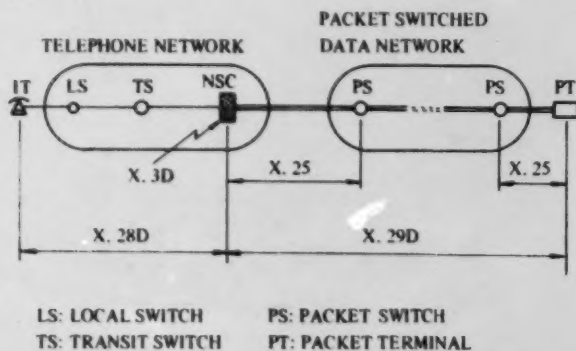
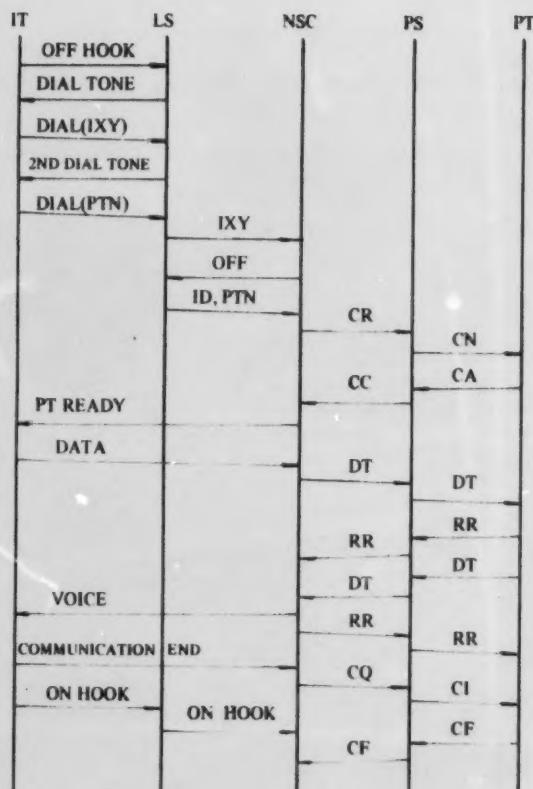


FIGURE 5. PROTOCOL STRUCTURE

3.3 SWITCHING SYSTEM

To apply the NSC system for intelligent telephone services, some minor function additions to a local switch are needed, such as originating subscriber number transfer and call termination without ringing. The NSC system provides such common functions as call connection control and subscriber data management, and such service dependent functions as code conversion, procedure conversion and media conversion. Figure 7 shows this switching arrangement for intelligent telephone services.



PTN: PACKET TERMINAL NUMBER

ID : ORIGINATING SUBSCRIBER NUMBER

CR : CALL REQUEST

CN : INCOMING CALL

CA : CALL ACCEPTED

CC : CALL CONNECTED

DT : DATA

RR : RECEIVE READY

CO : CLEAR REQUEST

CI : CLEAR INDICATION

CE - CLEAR CONFIRM

ON

FIGURE 6 A TYPICAL COMMUNICATION SEQUENCE

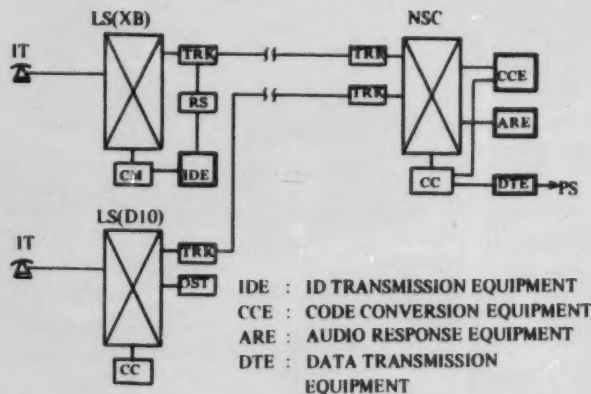


FIGURE 7 SWITCHING SYSTEM

4. DEVELOPMENT STEPS TOWARD AN ISDN

This section looks at development steps toward an ISDN from two aspects (8).

4.1 DEVELOPMENT STEPS IN A PHYSICAL NETWORK

In terms of a physical network, the network should be developed in such a way that networks facilities should be shared as much as possible by various services for them to be used most efficiently. It is known that digitalization of a transit network is particularly economical because of the benefit of integrated digital switching and transmission. So, network digitalization would start at the upper part of the network and gradually go down to local exchanges and eventually to subscriber lines, as is shown in Fig. 8.

In order to make available a fully digital link between terminals for digital services before complete network digitalization, it is desirable to give priority to final, rather than alternate, trunk digitalization (9).

Existing telecommunication networks consist of several service-dedicated individual networks. However, since common use of subscriber lines for various services is essential for realizing integrated services, the network part closer to the subscriber terminal should be shared by various individual networks. This arrangement is also economical because the traffic in small individual networks can be concentrated by the larger digital telephone network. The common use of facilities will advance from that of subscriber lines to that of junction and transit networks. However, it would be economical to separate the packet switched data network because of the difference in data transmission mechanism. Figure 9 illustrates these development stages.

4.2 DEVELOPMENT STEPS IN SERVICE PROVISION

In the existing mostly analog telephone network in Japan, such subscriber facilities as call waiting and call transfer are already provided. The application of the NSC system makes it possible to offer various non-voice services economically by using the telephone network as a concentrating network for the traffic of such services.

As the network is digitalized, there will be more demands for more diverse and enhanced services increasingly involving communication processing and information processing. Important considerations for network development in terms of service provision are service extendability, standardized subscriber interfaces and standardized interfaces between switching and transfer facilities, communication processing facilities and information processing facilities, for which NSC systems provide a very efficient means. Consequently, there will be an increase in the NSC categories, such as a new NSC system for the digital portion of the network and more NSC

ANALOG TELEPHONE NETWORK

DIGITALIZATION OF TRANSMISSION LINES

DIGITALIZATION OF TRANSIT SWITCHES AND TRANSMISSION LINES

FORMATION OF FULLY DIGITAL LINK

DIGITALIZATION OF LOCAL SWITCHES

DIGITALIZATION OF SUBSCRIBER LINES

— : DIGITAL TRANSMISSION LINE
□, ○ : DIGITAL SWITCH

FIGURE 8 DEVELOPMENT STEPS IN A PHYSICAL NETWORK

systems for individual networks. It will provide further non-voice services and interworking between individual networks.

As subscriber lines are digitalized, various individual networks will become integrated to form an ISDN, which will cause corresponding integration of NSC systems.

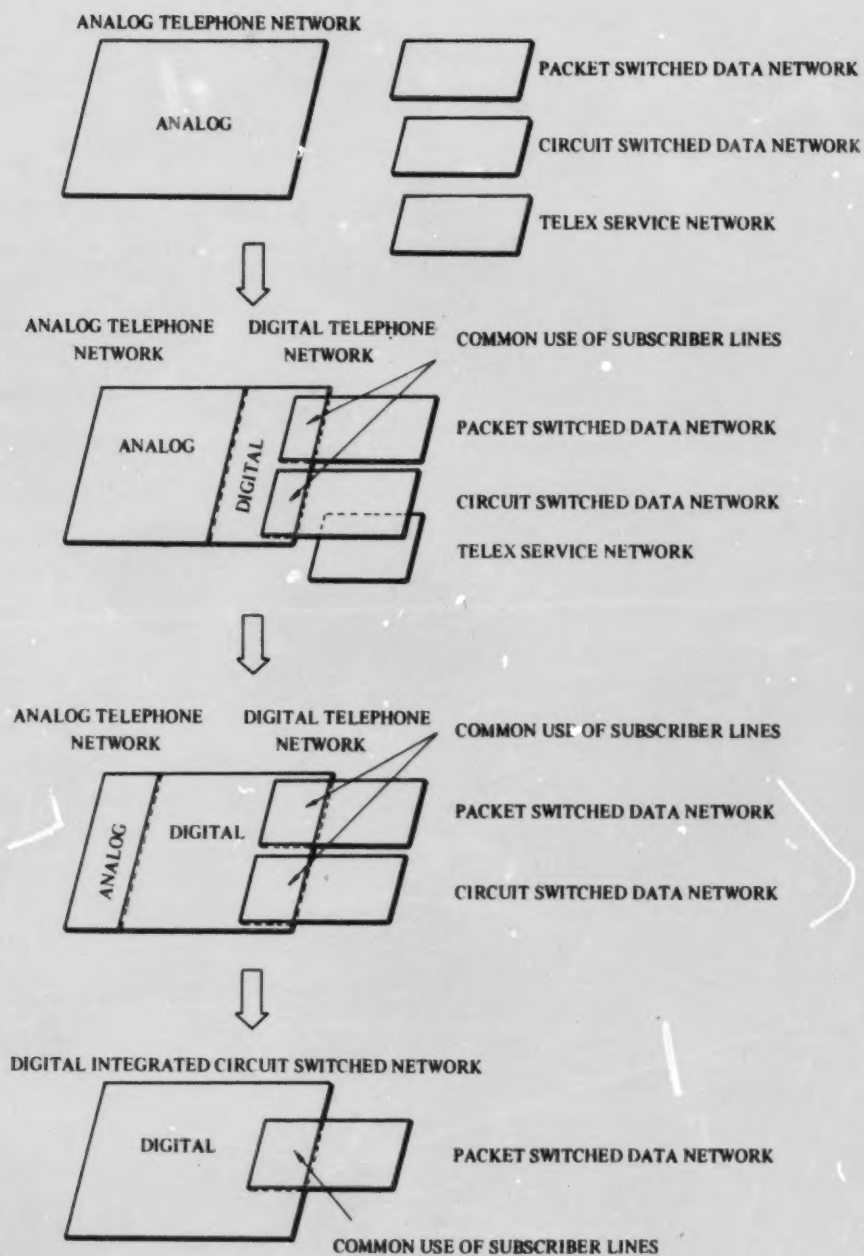


FIGURE 9 DEVELOPMENT STEPS IN COMMON USE OF EQUIPMENT FOR VARIOUS SERVICES

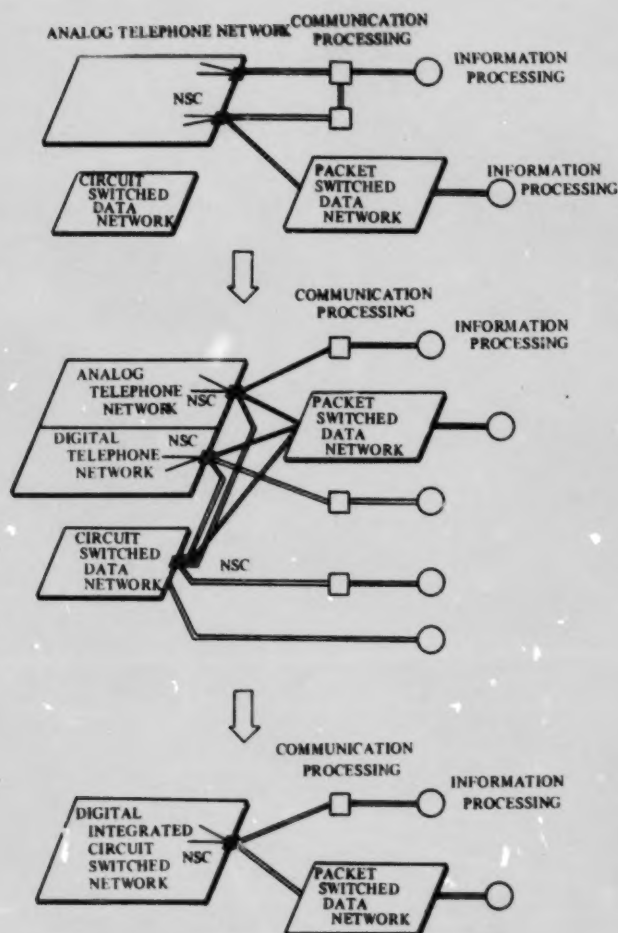


FIGURE 10 DEVELOPMENT STEPS IN THE NSC

5. CONCLUSION

In Japan, introduction of the NSC systems has made it possible to offer economically, even in a dominantly analog telephone network, such new services as a facsimile communication service with information storage and compression capabilities, a data communication service with an intelligent telephone, and credit card charging service.

As the telephone network evolves to an ISDN, the NSC systems would continue to be a useful means to provide interworking between individual networks and to provide new services whose traffic is limited.

Analyses from other aspects, such as signaling, numbering plan and tariff system, are required to complement the present study.

6. ACKNOWLEDGEMENT

The authors would like to thank Drs. K. Gotoh and M. Katoh for their guidance and encouragement. Appreciation is also due to all those in NTT who have collaborated in the NSC system study.

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Data Compression Applied To Video Teleconferencing

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Abstract

The paper describes the history of and reasons leading up to the development of video teleconferencing systems based on the current technology.

1.1 Essential Communication

During the earliest periods of man's interaction, the most elementary form of communication involved a combination of visual appearances and voice sounds. Shortly thereafter, man developed increasingly complex codes with which to communicate over greater distances and in less favorable conditions. The change in communication has led us thru various forms of sound systems (drums, horns), visual systems (bonfires, flags) and electronic systems (telegraph, telex). Coming full circle, we are now back to the duplication of the most primitive form of communication, Video Teleconferencing, where once again, two people who desire to communicate face one another and utter sounds to convey thoughts and desires.

1.2 The Cost Motivation

We have been using satellite television transmission to provide the connection for visual information since the 1940's, developing the complex capabilities of transmission to provide a world-wide network of transmitters and receivers. Commercial television enterprises have been using the media successfully on a world-wide basis for many years. Where much money could be made with the use of television, advertisers flocked to the opportunity, encouraging the growth of the industry. All of the basic equipment and techniques are now in place to allow the circle to be completed and the primitive communication to start.

1.3 Cost Reduction-Usage Increase

The only thing holding back the use of television conferencing is the cost. When users attempt to use the same facilities formerly developed for television, the associated costs of usage prevent all but the highest priority communicators access to the system. Over the next few years, this will dramatically change, due to the large effect caused by cost reduction.

1.4 Basic Redundancy

Most of the information usually transferred thru a television video and audio channel is unnecessary. This is because most of the information is redundant to other information in the communication. The redundancy results from an association that each element of the communication has with either its neighbor, or its correspondent in a subsequent frame of information. While one can see that the likelihood that a point of information on a frame of television is very great that it be identical to its neighbor, it may not be as obvious that there is the same similarity from frame to frame, although this is the case. If one can figure out a way to transmit the first full picture, a great improvement in data reduction could then be achieved by sending only the changes in the scene, rather than a complete second scene. The earliest forms of image compression have relied on this simple form of differential compression, taking advantage of the similarity of succeeding frames of video information. The only situation where this simple approach becomes inefficient is where there is little similarity

between succeeding frames. This would occur when there is substantial motion in the scene or when there is an actual scene change from one subject to another. In this case, the entire new frame must be reestablished before the motion can commence. Further refinements can be achieved by providing a prediction of what the new information is to be before it arrives at the receiver and then comparing the actual information with it. Predictive coding has been used in both the video case and the audio case in order to minimize the amount of information being transferred from one end to the other.

1.5 Voice Digitization

In the case of voice compression, predictive coding can be used to set up a model of what the voice will be saying before the utterance is actually made, allowing the prediction to perform some of the reduction in transferred information. By using some of the more advanced techniques available today, human voice is transmitted digitally at rates as low as 2400 baud, preserving most of the intelligence carried by the voice. In current video teleconferencing, however, very little voice compression is used in order to preserve the high voice fidelity demanded by the conference participants.

1.6 New Coding Techniques

As the state of the art has been changing in video compression, the techniques of relating adjacent points of information to each other to achieve the compression have been further perfected in the area of intraframe (within one frame) coding. With the perfection of the intraframe technique, substantially greater levels of compression can be achieved, allowing narrower bandwidths for transmission. The reduction in bandwidth carries with it a direct reduction in usage cost for

the transmission media. The current state of the art for full color, motion video allows this information to be transmitted using a 1.544 Megabits per second transmission path. When comparing this to the conventional television transmission channel of approximately 60 Megabits per second, one sees that approximately 40 channels of motion video can now occupy the same space formerly required by only one channel of broadcast television.

1.7 Computer Processing

The payoff is obvious. The cost reduction provided by data compression allows many more users of the existing television facilities on a cost effective basis. The transformation of the television signal from analog to digital has also allowed more computer control to be exercised on the data during transmission, allowing more efficient transmission and switching to be done on the signals as they move from place to place.

1.8 The User Pay-Off

The overall effect is one where a certain level of human movement from place to place will not be required to achieve that primitive communication posture for maximum intelligence transfer. The new technique of video teleconferencing will have a more widespread effect, however, in that an organization's efficiency can be greatly enhanced as more and more individuals in the organization can have direct contact with each other and more fully understand the directions and strengths that the organization possesses and can utilize. We will see not only individual organizations utilizing video teleconferencing to increase efficiency and lower costs; but in the long run, international communication can be enhanced without the requirement to travel long distances, furthering international understanding and world peace.

The Public Switched Network - A Current and Future View

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Abstract

The Public Switched Network in the United States is rapidly evolving into a Stored Program Controlled Integrated Services Digital Network. As such, it will be capable of transporting voice and data in ways undreamed of a decade ago. This paper reviews this evolution and emphasizes new call control and data transport capabilities.

1. INTRODUCTION

The Public Switched Network in the United States is a very large, complex, carefully planned, and highly coordinated system. The Bell System's part of the network at the end of 1981, consisted of 86 million working lines, 9820 local switching offices, 780 toll switching offices, 156 Traffic Service Position Systems (TSPS), and approximately one billion miles of cable, radio, fiber, and satellite circuits.

This paper briefly reviews the structure of the network with emphasis on its evolution to a Stored Program Controlled Integrated Services Digital Network. The main points are:

- a) The network is rapidly evolving and is making maximum cost effective use of new technology. This technology is used both to increase the efficiency and economics of the network, and to provide new basic capabilities from which new services will be made available to meet our customers' communication needs.
- b) The network is being designed with an array of basic building blocks which will allow rapid implementation of new services.
- c) The network, which in the past has used processors extensively, has now become one large complex computer. As such, services which were only possible on an intra-premise basis from advanced terminal equipment, are now becoming available over the entire network.
- d) Emphasis is being placed on making the network totally stored

program controlled with the ability to efficiently transport voice and data. This includes both circuit and packet switched data.

2. SWITCHING TECHNOLOGY [1]

The Bell System currently has over 300C Stored Program Controlled (SPC) systems in service. Figures 1 and 2 show the SPC growth in the local and toll areas. SPC coverage of local lines has now reached 49 percent and is expected to reach nearly 100 percent in the early 1990's. Local time division switching, including both the Northern Telecom DMS-10 and Western Electric's No. 5 ESS, has been introduced to the network. In the toll area, time division switching utilizing the No. 4 ESS, is well established, and will dominate as we move through this decade. In sparse areas we have begun to implement remote switching systems served from an ESS host. First service has been with the 10A RSS. Over 90 percent of our operator handled traffic is served by TSPS units.

PROJECTED BELL SYSTEM LINES IN SERVICE ($\times 10^6$)

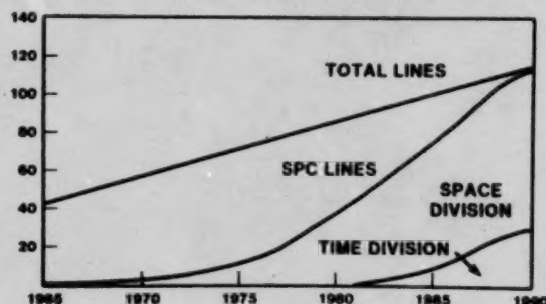


Figure 1

PROJECTED BELL SYSTEM TOLL TERMINATIONS ($\times 10^6$)

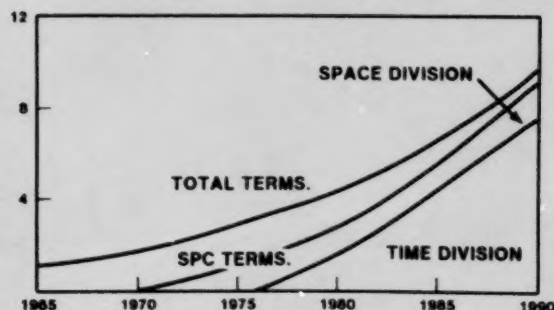


Figure 2

2.1 Time Division Switching [2, 3, 4, 5]

In the Bell System, the principal time division switching system up to this time is the No. 4 ESS. This system, can grow to as large as 107K terminations and can handle 550K call attempts per hour. Since 1976, when the system first went into service, the No. 4 ESS has had six major software releases making it feature rich, and much of the hardware has been redesigned to take advantage of new technology. This has had a dramatic effect on the cost, power, and space requirements, each of which has been reduced by over 50 percent.

First service for the No. 5 ESS, which applies time division techniques to local switching, was in Seneca, Illinois. In contrast to the No. 4 ESS architecture which is based on a powerful central processor, the No. 5 ESS architecture is based heavily on distributed control. To support that concept, powerful microprocessors are used in all of the peripheral modules. The central processor performs more global control functions as well as over-all administration and maintenance of the system.

An evolutionary plan has been established to provide a size range from very small offices to large offices of at least 100K lines with a large complement of customer, network, and administrative and maintenance features. Figure 3 shows an overall block diagram of the No. 5 ESS.

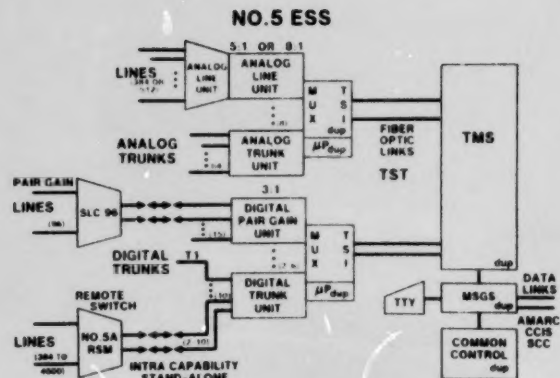


Figure 3

2.2 Signaling [6, 7]

One of the most rapid areas of network change has been in its signaling system. The dominant signaling method in the past had been via inband single and multifrequency units. Briefly, dedicated to each end of each trunk was a single frequency (SF) unit that was used to transmit and receive trunk control information. When a customer's call in being set up, this unit first tells the next office to prepare to receive digits. Then the multifrequency (MF) unit transmits the dialed digits to the next office.

Figure 4 illustrates what physically happened when Common Channel Interoffice Signaling (CCIS) was introduced. The MF and SF equipment is replaced by a specialized packet data network. This data network consists of terminals, data links, and signal transfer points (STP). Now, both control information and dialed digits can be sent from the originating office to the terminating office via this common data network. Included in the design is a Voice Path Assurance (VPA) test. For each trunk on every call, a tone is applied and a verification is made to assure adequate transmission quality. Under this design, the same coast-to-coast call that took 10 to 20 seconds to establish when SF and MF equipment was used will now take approximately 2 seconds. By year end 1981 the signaling for approximately one half of the 1 million toll trunks was over CCIS.

INTEROFFICE SIGNALING (CCIS)

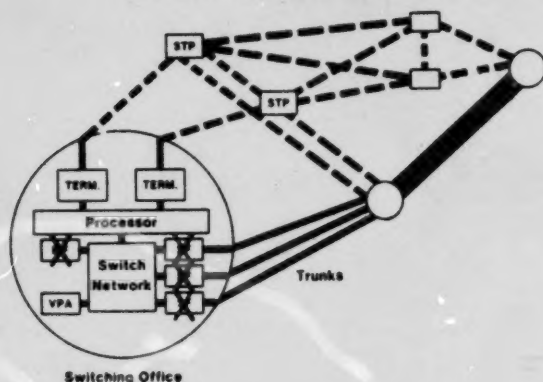


Figure 4

CCIS has many benefits. We are able to eliminate the expensive trunk equipment used for signaling, it is easier to test circuits, calls are set up faster and more accurately, there is less chance of fraud and a great deal of flexibility is added to the network. When CCIS was designed, significant flexibility was built into it. A structure was created to allow any point in the SPC Network to send a message to any other point in the network, for any reason, at any time. This is a key element that makes possible the cornucopia of new services that we are calling Direct Services Dialing (DSD).

3. DIRECT SERVICES DIALING [8, 9, 10]

The way we plan to use the flexibility of CCIS for DSD is shown in Figure 5. A calling party dials some type of special sequence. The network, recognizing this special sequence, routes the call to what we call an Action Point (ACP), which may be the originating local office, a toll office, or a Traffic Service Position System (TSPS). The Action Point temporarily suspends the progress of the call set-up. In effect it says: "I am not smart enough to know how to handle this call and must send a CCIS message to a Network Control Point (NCP) to get more information." In some cases the Action Point requests additional digits to be dialed by the caller.

SPC NETWORK SERVICE PLAN

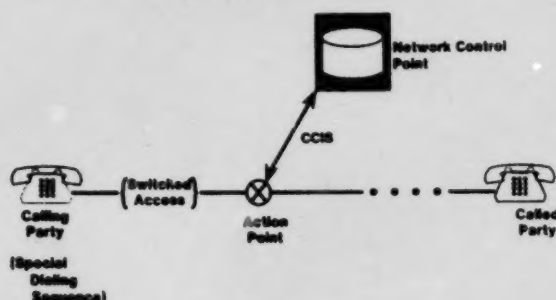


Figure 5

A Network Control Point is a network node which contains detailed logic and data about how specialized calls should be handled. After the message is received, the Network Control Point instructs the Action Point on what to do. In many cases the call then continues to be routed over the network according to the instructions from the Network Control Point. Note that an inherent aspect of this plan is universal access - any telephone can have a call routed to an Action Point to receive DSD treatment.

3.1 Mechanized Calling Card Service [11]

One application of this architecture is mechanized Calling Card Service. This capability, illustrated in Figure 6 would allow a caller at a telephone equipped with TOUCH-TONE® or equivalent service to dial 0 plus the number being called followed by a billing number and a Personal Identification Number (PIN) associated with it. It can be thought of as automating telephone credit card service, which presently uses an operator. The call is routed to a TSPS, serving as the Action Point which sends a message to the Network Control Point, requesting a validity check of the billing number and PIN combination. If the billing information is valid, the call is allowed to proceed and no operator is needed.

MECHANIZED CALLING CARD SERVICE

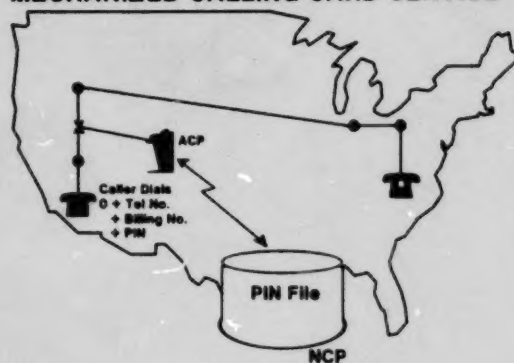


Figure 6

3.2 Expanded 800 Service [12]

Another application which has been developed is an expanded 800 Service. Eight-hundred Service, which used to be called Inward WATS, is designed such that the called party is charged for the calls. It is a very popular business service and is heavily used. Figure 7 illustrates the new 800 Service architecture. All 800 number calls are routed to an Action Point which is capable of determining the originating area code of the calling number. An inquiry, using CCIS, is sent to a Network Control Point for geographical screening, terminating line status checking, and mass call monitoring. If the call passes these checks, a specially assigned telephone number is returned and the call continues to be routed as any other call. For each 800 number, the returned special telephone number can be a function of the originating area code, the time of day, day of week, and/or the busy/idle status of the destination. The data base is kept informed of the latter item by having local offices report changes in the busy/idle status of 800 service line groups.

These flexibilities yield the following benefits: automatic routine of calls to different business locations, allowing localized answering through a single permanent nationwide number; reduction in the amount of telephone equipment involved in, and hence, the cost of ineffective attempts since the busy tone can be given from the Action Point rather than from the terminating office; simplification of 800 Service numbering and routing; and automatic monitoring and control of mass calling.

IMPROVED 800 SERVICE

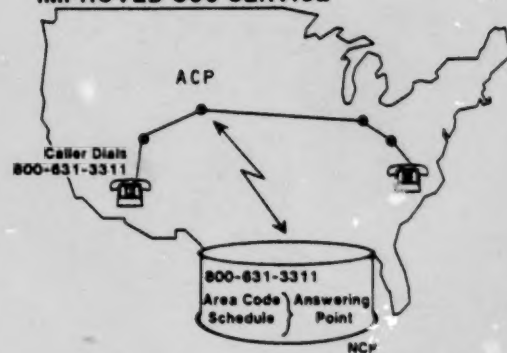


Figure 7

3.3 National Number Calling

Suppose a national Auto Club wanted to have a single telephone number that members could call at any time and from any place where their car breaks down. In Figure 8, such a stranded traveler, is shown at a public telephone. He dials their single nationwide number. The call is routed, according to directions given to the network by the Auto Club, to the nearest open service station, which sends a tow truck. This and other such services could be provided utilizing the same basic network building blocks that were used for Mechanized Calling Card Service and expanded 800 Service.

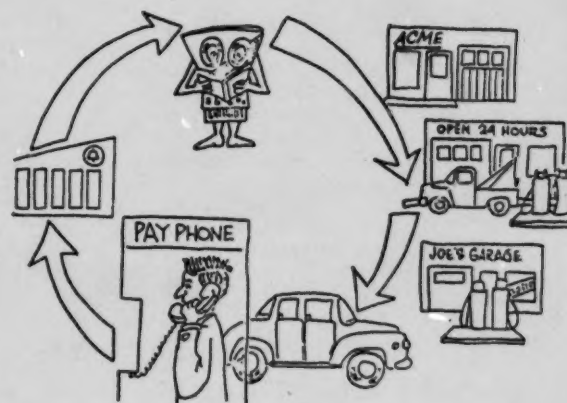


Figure 8

4. SWITCHED DIGITAL CAPABILITY [13]

The Stored Program Controlled network is built on the foundation of digital technology for control and signaling. Digital switching and transmission technology is now in widespread use in the SPC network to provide high quality, cost effective telephony. The SPC network is evolving into an Integrated Services Digital Network (ISDN) [15]. A fundamental ingredient of ISDN is the capability for making end-to-end digital connections through the SPC network. Applications may include high speed facsimile, encrypted voice, bulk data transfer, or teleconferencing.

Allowing establishment of such connections just like ordinary telephone calls, this Switched Digital Capability (SDC) has the potential to make switched, high speed digital communications almost as ubiquitous and easy to use as today's voice telephony. SDC resembles, in many respects, DATAPHONE® service on the public telephone network, in that it can provide common user circuit-switched connections which can be used alternately for voice and data. But it also can provide some of the desirable features of DATAPHONE® Digital Service (DDS) leased lines, such as a 56 kb/s data rate, digital data transfer, and full-duplex operation.

Figure 9 shows the SDC architecture. It builds on the large base of compatible digital equipment in the SPC network. It takes maximum advantage of existing switching and transmission systems. The required modifications to existing equipment are mostly in software and in plug-in circuits. Only a limited portion of the network need be equipped for digital transmission, since SPC switches can selectively route SDC calls.

SWITCHED DIGITAL CAPABILITY

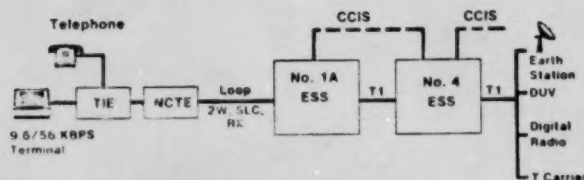


Figure 9

Customer access will be over existing 2-wire loops utilizing Time Compression Multiplex technology [14]. The No. 1A ESS has a space-division metallic network, which is being used today to switch analog signals. Experiments at Bell Laboratories have shown that it has the capability of switching and transmitting high speed digital bit streams. When used in this mode, the No. 1A ESS becomes, in effect, a space-division data switch. Since the No. 4 ESS switches standard 64 kb/s voice channels, it can be readily adapted for end-to-end digital connections.

Although most long-haul voice circuits now use analog facilities, a substantial amount of long-distance digital capacity has been built for DDS, among other applications. As demand grows, a wide range of inter-city digital systems can be installed as needed. These include Data Under Voice (DUV) and similar systems, digital microwave radio systems, fiber optic systems, digital satellite systems, and digital systems which displace part of an analog system on radio or coaxial cable. By selectively turning off or avoiding equipment such as echo cancelers or suppressors which could cause errors in the bits, these digital transmission systems will be compatible with a transmission plan for SDC.

5. PACKET SWITCHING

The Bell System recently announced a technical interface for a basic packet transport capability. A detailed protocol description, based on the international CCITT X.25 specification, was issued in 1981.[16] Briefly, the types of packet capabilities that are planned include virtual circuits, permanent virtual circuits, 56 kb/s and 9.6 kb/s access, hunt groups, and fast select, with high availability and reliability. Studies have shown that the type of data transport which is bursty, with low utilization of the transmission path, is best served by packet switching technology.

5.1 Local Area Data Transport

One such bursty data application is Home/Business Information Services. In this service, an information provider transmits pages of text and graphics to a home or office for display on a terminal or television set. Many marketing trials of such services are underway worldwide, utilizing telephone

lines or cable TV. While the existing telephone network can be used for such services, studies show that it would be more efficient to use packet switching technology. Furthermore, it is highly desirable for such services to be independent of voice capabilities so that the telephone line is not tied up on long holding time data calls. A solution to these problems is illustrated in Figures 10 and 11.

DATA SLC

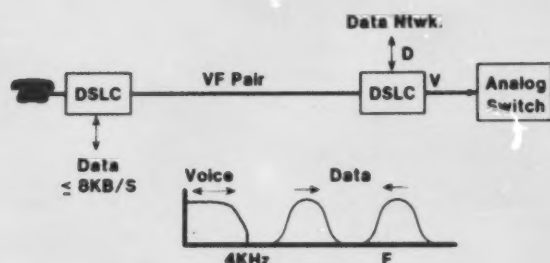


Figure 10

LADT Architecture

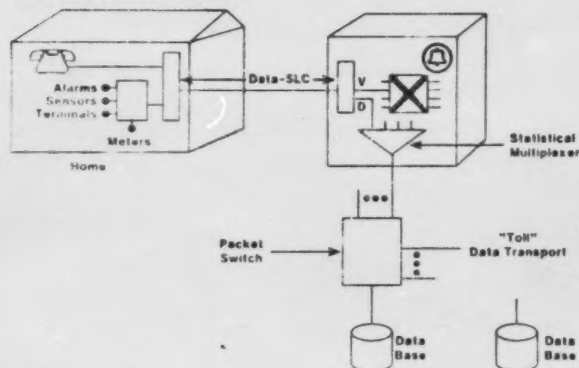


Figure 11

Here, a subscriber loop carrier system, called Data-SLC, combines the voice signal with a data signal of up to 8000 bits per second. At the central office the data is separated from the voice signal and combined with other data signals through a statistical multiplexer. Through an appropriate Data Network Interface the data can be sent to a packet network for interrogation of a data base or transmitted to another terminal. Such a basic transport capability is currently under development for the Bell System.

6. CONCLUSION

The challenge of the future is to find ways in which technological capabilities can be harnessed to meet customer needs. In the Bell System we are making extensive use of stored program control and digital technology to meet this challenge. Some of the services mentioned above that are now being implemented indicate that we now have the technology available to provide a wide array of communication capabilities. We are on the verge of adding an increased level of intelligence to the public switched Network to provide highly innovative and useful services for our customers.

The author hopes that he has been able to communicate to the reader a sense of the excitement and challenge the future holds for the Public Switched Network.

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New Services and Network Development

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With the public demand for traditional telephone service fully met in most regions of the world, comprehensive plans are being evolved for the provision of a wide variety of non-voice as well as enhanced telephone services on common telecommunications networks. Indeed, as we enter into the age of the information society, the full exploitation of the vastly expanded and rapidly developing capability of terminal equipment can only be ensured by a complementary evolution of the switching and transmission systems. There is no doubt that the symbiosis of these two developments will provide opportunities which have never before been available to the subscriber of telecommunications services.

In order to ensure the effective and harmonious introduction of the new services, it is essential that a number of important related considerations be given adequate attention in the context of domestic and international telecommunications. Firstly, it is generally agreed that as the telecommunications systems evolve, coherent and consistent methods and procedures must be developed to allow interworking of different terminal equipment connected to the public national and international networks. Early standardization is not suggested here since it can potentially stifle innovation. However, effective integration of new services to the public network requires a timely agreement on a common set of standards without which interworking would not be possible.

A second important aspect in the context of service development is whether the functions of call recording, billing and accounting for revenue sharing have been given adequate consideration. Tariff levels for new data services tend to be much lower than corresponding costs per bit for the traditional telex and telegraph message services. Consequently, one will wish to ensure improved efficiency of these functions if the profitability level of the telecommunications operator is to be maintained. Constraints in respect of these functions may also limit the variability of new service offerings. It is therefore important for the network to be developed with this consideration in mind.

With the direct dialed domestic and international subscriber access to an increasingly complex network, it is essential to provide an effective computer-based network monitoring and control capability both for the early and accurate identification of traffic congestion and/or fault conditions and also to provide means for action to alleviate the impact of such conditions. Closed loop control of the network functions via computer systems may become a requirement for effective network management. In the international network, such closed loop control would require a high degree of bilateral and/or international agreements with some probable sacrifice of autonomy by each administration.

A further consideration is whether the routing capabilities of the switches currently being implemented particularly in the telephone network can be upgraded to meet some important additional complexities of the future digital network. It is foreseen, for example, the 32 kbit/sec and perhaps even 16 kbit/sec encoded and interpolated speech systems may be utilized in some national networks and in some segments of the international network. In the probable event that it may be necessary to limit the total number of such systems in an end-to-end connection, the resulting routing constraints could impose new and unforeseen requirements in respect of switching capability and network routing algorithms. Furthermore, to the extent that new service options in respect of non-voice transmissions may allow the subscriber to select a particular quality of service for his connections with an associated constraint on the overall end-to-end transmission and storage delay, such new service options could also challenge the routing capabilities of the switches and require upgrading of the network algorithms.

These considerations are vital to the satisfactory implementation of new services on the evolving digital network.

FUTURE TECHNOLOGY:
THE DEVELOPMENT OF TELECOMMUNICATIONS OVER THE NEXT DECADE

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Human communication is changing. During the last two decades, the use of technical advances in telecommunication has become one of the most prominent characteristics of human activities.

At the turn of the century, cinema, newspapers and telegraph were the predominant communication technologies of the time. Today, we are aware of the fact that, by the turn of the 21st Century, life will be completely different from the preceding century and, in most cases, communications technology will be responsible for these changes.

Radio, television, telephones, computers, satellites, fiber optics, etc., have come to stay, and even though they started as independent media, they currently are at a stage of interlinking themselves or fusing into a one integrative technology.

Even though more communications technology is coming into existence, like holography, or three-dimensional TV, or digital telephony, most of it will be a development of existing technologies rather than brand new technologies.

This allows us to divide our thinking, in the future, into two arenas of study:

- Creation and growth of new communication technologies.
- Development of existing communication technologies.

Probably, of these two, the one that will have more profound influence in human life is the developmental one. Since we know, from experience, that it took television—one of the most

widely spread communications technologies—over forty years to become part of the everyday life of the population, in general, of the most important country in the Western world.

In relation to the development of existing communications technologies, we are gradually facing the marriage among technologies. This can probably be summarized in two concepts.

For the working environment, the so-called "office of the future," and for the home, the so-called "electronic cottage." Both, in general, a combination of carrier type of technologies, fiber optics, microwave, telephone lines, satellite terminals with contents ranging from data transmission, voice, video, video with associated audio, in interactive or single modes, scrambled or cryptogrammed with addressable capabilities that will allow the end user to enter through a television screen with keyboard commands into a network or networks of information and communication. Kind of a hook-up to the world. This will further enhance the concept that we are driving toward what many people refer to as an "information society." Also, the existence of these information/communication networks will allow a further decentralization of life from the main cities into countryside, which is an urgent need in countries like Mexico and in most of Latin America.

All this technology is creating, in a word, alternatives. Alternatives which require an evaluation of side effects, but this is a matter of a different discussion.

And, for the first time in human history, society could become not just an add-on of individuals, but the interactions that take place among them.

THE TECHNICAL ASPECTS OF FUTURE
TELECOMMUNICATIONS SERVICES
--A GENERAL SCOPE OF OVERALL TELECOMMUNICATIONS FACILITIES

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1. Abstract

A trial rough structure classification concerning overall telecommunications facilities is presented. This system concept set seems to be useful for the deployment of technical discussion on future telecommunications services. In association with this classification, some possible technical trends for future telecommunications services are pointed out.

2. INTRODUCTION

It seems that the technical aspects of telecommunications services are to be considered in connection with the structure of overall telecommunications facilities ^{1), 3), 4), 6)} which share various telecommunications subfunctions and evolve on a step-by-step basis, utilizing many kinds of technological progress. One telecommunications facilities structure analysis method is to identify the following three functions (facilities): i.e.

- (a) Communication terminals where man-machine interaction interface is the center of interest.
- (b) So-called transparent telecommunication networks, which are composed of transmission links and switching/connecting nodes in a broad sense from either physical or logical standpoints.
- (c) Intelligent information facilities of various kinds and of various allocation categories.

3. COMMUNICATIONS TERMINALS
(MAN-MACHINE INTERFACE)

Most world-wide prevailing communications terminals, of course, fall into the following three categories: (1) Telephone station set. (2) Radio audio program broadcast receiver set. (3) Television program broadcast receiver set.

The main telecommunications service application of the telephone set has been human-to-human balanced bothway (interactive) vocal communication, utilizing natural languages on a demand basis at any time between any locations (between any persons). It is just like an extended mouth/ears aid.

The radio broadcast audio receiver has been mainly applied to oneway (informative) audio communication (receiving only) utilizing natural languages, music and other human-audible signal forms.

The television receiver set has been mainly applied to oneway (informative) video/audio communication (receiving only) utilizing moving picture, still picture and other human-visible signal forms in combination with human-audible signal forms. The television receiver set is just like the extended eyes/ears aid. In contrast to this, the radio audio receiver set is considered an ears aid only, although the range of program selection freedom is much wider in terms of location of program transmitting stations.

Besides the above three kinds of terminals, other communication terminals, such as telex terminal, facsimile terminal, data communication terminal, teleprinter, pager, mobile telephone terminal and, most recently, the personal computer/work processor etc. are already utilized in proper application fields, of course.

Large-scaled EDP, various information storage and retrieval systems for data/text/audio/video categories, central portion of telebanking systems etc. are recently operating through interconnection with telecommunication networks. They can be described as several kinds of terminal in a broad sense, but perhaps they should be called communication equipment/system in order to make a distinction between them and ordinal simple terminal equipment with a single set of man-machine interface subsystem. They are also distinctive by the fact that they make possible Human-to-Machine communication with the help of a simple terminal on the Human end of the system, and Machine-to-Machine communication among themselves.

In this article, communication equipment/systems such as the above are classified as a kind of intelligent information facility, discussed in Section 5.

Introduction of TELETEX and TELETEX services will have a strong impact on current television receiving set and telex terminal, respectively. Another impact on the use of the television set might appear if High-Definition television service²⁾ is hopefully realized in the future. Introduction of VIDEOTEX service will have a

strong impact on the possible integration/inter-working of telephone set, television receiving set and/or other non-voice information oriented communication terminals.

Various switched data communication services and future multi-communication service integration are related to development and introduction of intelligent/multi-service oriented integrated communication terminals.

4. TRANSPARENT TELECOMMUNICATIONS NETWORKS

Telecommunications networks provide an efficient and effective signal transfer means for various specific communication connections between communication terminals or among communication terminal and intelligent information facilities, which are discussed in the following Section 5.

4.1 TRANSMISSION LINKS

Transmission links in a network can be classified into (1) point-to-point and (2) multiple access categories.

Point-to-point (P-T-P) transmission links are observed in the form of, for instance, twisted copper wire cables, long haul coaxial cables, micro wave links and very promising optical fiber links connected through specific use repeater facilities as well as pertinent multiplexing end terminal equipment, as necessary. They are currently essential elements in public switched telecommunication networks in almost all phases: local, short haul, long haul, trans-ocean terrestrial links, the back-bone of public broadcast program distribution networks, and other leased circuit transmission facilities groups.

Multiple-access (MA) transmission systems can be interpreted as broadcast transmission systems from a single/information sender standpoint. They are of course essential elements in broadcast program distribution systems utilizing radio wave network and CATV tree network. The MA category also includes stationary satellite communication systems of various kinds: domestic/regional/ocean zone basis; trunk communication use and direct broadcast use. The other systems in the MA category are growing into an intra-premises local area network for office automation (OA) and factory automation (FA), and customer access network or local carrier (distribution) network for enhanced public switched telecommunication networks.

The advantage of MA transmission systems is the capability of economical high-bit-rate/wide frequency band signal transferring function concentration towards particular ports or nodes.

4.2 SWITCHING NODES

Switching operation modes for various telecommunications network nodes can be classified as follows: (i) Non (semi-permanent)-switching. (ii) Circuit (line) switching. (iii) Packet (block) switching.

The first mode, non-switching, means that the switching gear makes action relatively rarely, based upon program scheduling, network maintenance and operation etc., and not based upon service demand from communication terminals.

The second mode, circuit switching, is currently the most fundamental switching mode because this is applied to globe-wide public telephony communication service on a demand basis from anybody at any time to any place utilizing any of about 500 million telephone subscriber station sets working as traffic source/sink in the international/national network.

The third mode, packet switching, is also important from the viewpoint of its matching bursty and/or unbalanced twoway (reactive) communication falling into the human-to-machine, or machine-to-machine categories. This mode is currently utilized in relatively lower bit rate transmission environment in a public data network, in parallel with a public data circuit switching network. However, it seems more appropriate rather to higher bit rate environment as already recognized concerning with private/public local area network application in combination with the above MA transmission facilities.

Packet switching mode seems also suitable to some kinds of human-to-machine communication services in combination with the intelligent information facilities discussed in the following. The trends of packetized voice communication draws attention from the viewpoint of pursuing so-called universal and versatile switching mode in the future for Integrated Services Digital Network (ISDN).

The diversion of some switching related functions from conventional switching nodes are being studied. One direction is oriented around customer access network system in ISDN application. Another direction is in the transit network domain and includes the possibility of the switching gear in the sky⁵⁾ in connection with enhancement of Satellites-Switched-Time-Division-Multiple-Access-Space-Division Multiple Access (SS/TDMA/SDMA) satellite communication system.

5. INTELLIGENT INFORMATION FACILITIES

This terminology, "intelligent information facilities" could be a newly proposed term with a very wide meaning. Various telecommunications service-oriented common-use systems/facilities are considered as being included, as already briefly and partially discussed in Section 3 above.

Examples are:

- (a) Audio radio program broadcasting centers, which provide and generate audio programs to be received by the above mentioned communication terminal: radio (audio) program receiver set, via pertinent transparent network portions discussed in a previous section.

- (b) Television program broadcasting centers, which provide and generate television programs as well as future TELETEXT program to be received by the above television receiver set.
- (c) Various information file (storage and retrieval) systems for data/text/audio/video message type, which can include information bank for VIDEOTEX service or can act as Store and Forward systems in a pure and narrow sense, to store messages on their way from originating terminals to final destination terminal via transparent telecommunication networks.
- (d) Various Electronic Data Processing (EDP) systems, which are accessed remotely by pertinent communication terminals via transparent telecommunication networks.
- (e) Various signal processing facilities, including media conversion categories such as voice recognition facilities, voice synthesizer, data code converter and communication protocol converter.
- (f) Various word/text/image processors.

It is difficult to come up with a well-balanced definition of this new terminology: "Intelligent Information Facilities", at this stage in the investigations. However, summarizing the common features of the above examples, input information is processed, combined and, in many cases, stored/delayed in proper lapses of time before being put out to the final destinations.

These facilities are in many cases centralized, but they are not necessarily centralized except in case of (a) and (b) above. Extreme cases of decentralization/distribution are direct attachment/integration to communication terminals and allocation in subscriber premises. Sometimes, they can be attached/integrated/allocated with various elements of transparent telecommunication networks.

Anyway, future development on telecommunications will be realized, not only in the above conventional communicating terminal and transparent telecommunications networks, but also in these intelligent information facilities, in connection with, of course, general computer and communication technology development.

6. CONCLUSION

A very brief observation about overall telecommunication facilities structure is presented. Here, three fundamental categories: communication terminals, transparent telecommunications network and intelligent information facilities, are proposed, along with pertinent sub-classifications.

Some possible technological trends for the future telecommunication services and corresponding facilities are hinted at in a broad and rather abstract way.

This short article is only to provide preparatory information to be utilized hopefully effectively in the actual panel discussion under the same main title.

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Future
Telecommunications
Systems and
Services:
Business and User
Considerations

Satellite Broadcasting In Australia

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1. Abstract

With the launch of the National Communications Satellite System in 1985, Australia will move towards the provision of broadcasting and other telecommunications services on a more equitable basis. The use of the satellite system for direct broadcasting raises significant policy issues which will require early resolution if its full potential is to be realised. A period of technical, social and programming experimentation with satellites, as is the case elsewhere, has not been a feature of Australia's approach to formulating a satellite broadcasting policy. The opportunity appears to exist for socially advantageous and potentially economic broadcasting uses of the system in a manner that permits a developmental approach to direct broadcasting by satellite in advance of practical international experience on which to base firm policies.

2. INTRODUCTION

In many countries the size of Australia, the ability to extend existing national telecommunications services to those areas not now served is restricted by the impracticality of using conventional technology to reach remote or dispersed populations - a situation shared by many Pacific nations.

For many people in these circumstances, satellite communications offer the only practicable solution to the problems of how to provide any services at all within a reasonable timescale. Similarly, for others, satellite communications hold out the only hope for the improvement of poor services, or for enabling access to a wider choice of services.

3. BACKGROUND TO AUSTRALIAN BROADCASTING

About 80 per cent of Australia's population is concentrated in the narrow eastern and south-eastern coastal strip with a substantial population in Perth. In these areas, the broad range of telecommunications services can be provided by available technology in the most cost-effective way. But what of the areas outside the reach of the present network? Almost 300,000 Australians are outside the nominal coverage of national (Australian Broadcasting Commission) television stations. Of these, some 120,000 have little or no hope of gaining access to this television service via terrestrial means in the foreseeable future. In addition, there are almost one million Australians who suffer less than satisfactory television reception. A similar situation exists for radio with 375,000 people living outside the normal reach of the medium frequency ABC stations. In these areas, satellite technology may be the only means of allowing connection to the network.

4. BROADCASTING DEVELOPMENT GOALS

In a statement to Parliament in 1979, when speaking of present proposals for a National Communications Satellite System, the then Minister for Post and Telecommunications, Mr. Staley, said:

"We can no longer ignore the rights of our fellow Australians to equitable access to communications facilities and to those services which cannot be provided without such facilities."

Mr. Staley, in effect, identified broadcasting objectives for a "first generation" satellite system as being to:

- extend the availability of existing broadcasting services to as many Australians as possible;
- increase the diversity of broadcasting services available to the public.

The goal behind the objective of providing people in remote and underserved areas with broadcasting services, is therefore to provide reasonable parity with other Australians who enjoy a choice of national, commercial and public broadcasting services, and who have freedom to receive any broadcasting signals they choose.

Some people in regional (rural) areas with limited services already augment their choice by using elaborate antennas to receive signals intended for other areas. People in remote and underserved areas should therefore enjoy access to a range of broadcast signals, whether or not they are specifically intended for them.

5. SATELLITE BROADCASTING POLICY

The first generation of the National Communications Satellite System, called "AUSSAT", is to be launched in 1985. Its initial broadcasting applications will include bringing the ABC's national television and some sound services to parts of Australia that cannot at present receive them adequately, if at all. There is also an option for limited facilities for other possible broadcast services, either commercial or public or both.

Beyond this, no comprehensive policies exist at present for the growth of broadcast services via

satellite within Australia. To the extent that such policies can be developed in advance of practical experience, it is necessary to anticipate likely needs and problems as a basis for planning the direction and pace of growth of satellite broadcasting, both within the first generation system, and in later generations.

A policy for broadcasting via satellite involves reconciling socio-economic, regulatory and technical elements in a way which closes fewest options for the future.

5.1 SOCIO-ECONOMIC/REGULATORY ASPECTS

It is necessary to anticipate and progressively develop an understanding of the following topics in the context of the Broadcasting and Television Act 1942:

- the likely scale and type of broadcasting needs in Australia generally, whatever their means of delivery;
- the extent to which these needs should be met by satellite or other forms of delivery, eg. over-the-air, cable services;
- the consequent role of satellite services in broadcasting generally;
- the aspirations of existing and future broadcasters for supplying services to meet these needs, especially via satellite;
- a comparison of a realistic range of options for developing satellite facilities to assess how well each option would meet broadcasting needs as they are currently understood;
- the consequent scale and timing of provision of satellite facilities and associated regulatory policies to implement the preferred option for developing broadcasting via satellite.

Some general broadcasting objectives within which more specific needs should be established to assess options for domestic satellite services are:

- to increase the choice of programming available to the public;
- at the same time to increase the diversity of programming available to the public in general and to community groups with special interests;
- to achieve this in a manner that will encourage the spread of services to underserved communities as well as major markets;
- in this process, to encourage the further development of Australian cultural identity;

- and to provide appropriate support for local community interests.

These objectives have significant ramifications for planning of future satellite broadcasting services.

At present, any person in Australia is entitled to receive any broadcasting service. However, to control the influence of broadcasting and encourage localism, the ownership and range of broadcasting stations is effectively restricted to a limited number of markets or service areas. More recently, Government policy has moved towards the actuality of networking, provided that local stations are given reasonable protection to preserve their viability, quality and local content. This does not necessarily mean that satellite transmissions will always be the most commercially acceptable method of program delivery to other markets. Delivery can take place either via direct broadcasts or by relay to distant markets for, say, controlled distribution via cable.

By its nature, satellite broadcasting transcends territorial boundaries. The concept of limited markets or service areas for commercial broadcasting via satellite is inconsistent with its capabilities for meeting the first objective of providing more choice of stations for the public. There is, however, no reason why the concept of limited markets should not remain for terrestrial broadcasts, including cable and over-the-air subscription services. This would provide the required protection for local terrestrial stations distributing their signals to people with conventional antennas and receivers, at least until it becomes clearer whether the future of broadcasting lies with direct broadcasting, cable services, or some other form of delivery. In the long term, the choice between direct broadcasting on one hand, and relay to cable or over-the-air services on the other is likely to be primarily a commercial decision. (For less isolated viewers, the choice would depend more upon whether direct broadcasting offers new types of services).

One important consideration in the development of policies concerning cable television (CTV) and subscription television (STV), if either or both are to be introduced, is their possible impact on existing components of the broadcasting system. Another consideration is the contribution they could make to the overall efficiency of the system, and, in this regard, it is necessary to consider their applications and their interaction with other broadcasting delivery systems. Direct-to-home satellite television, including STV, could also increase choice and diversity. It could lead to a more equitable distribution of broadcasting services to remote and underserved areas as well as regional and metropolitan areas. More investigations are needed of the comparative economics of CTV and direct-to-home satellite television services.

5.2 TECHNICAL OPPORTUNITIES

Satellite technology basically offers two opportunities to broadcasters:

- Fixed Services, which permit the distribution and exchange of program material between stations on a point-to-point or point-to-multipoint basis;
- Direct Broadcasting Services, which provide a totally new opportunity to broadcast direct to homes and communities.

5.2.1 FIXED SATELLITE SERVICES

There is nothing new about the fixed service application, but our proposed satellite system should overcome inadequacies in present terrestrial distribution facilities, especially over long distances.

Consultation with potential users suggests that substantial system capacity could be taken up for two main fixed service applications:

- program assembly and distribution between studio centres;
- relay of program material from an originating studio for re-broadcast from regional terrestrial transmitters.

These major intended uses of AUSSAT are exactly similar in concept to the existing terrestrial distribution of program material by both the ABC and commercial broadcasters. They do not directly raise new broadcasting licencing or policy issues. However, the increased availability of program material from distant sources should lead to requests for supplementary or new commercial television and radio licences to provide outlets for it in regional areas. This will require progressive detailing of current general policies in respect of networking, protection of localism, and preservation of independence of regional broadcasters.

The main policy issues raised by Fixed Satellite Services relate to:

- the Government's decision to encourage networking arrangements between stations;
- the establishment of additional commercial stations to permit an expansion of networking;
- the completion of frequency allocation policy studies and consultations to facilitate the above;
- the possible need to control in some way the use of satellite transponders for broadcasting purposes.

5.2.2 DIRECT BROADCASTING SATELLITE (DBS) SERVICES

A major technical difference between point-to-point

or Fixed Satellite Services and DBS is that, with DBS, the burden of cost is placed on the satellite or space segment so as to minimise the cost of earth stations or ground receivers to consumers.

In actuality however, the distinction between fixed services and direct broadcasting types of services is not as sharp as the words suggest. In this regard, the four medium-power transponders designed for each spacecraft on our proposed system - generally referred to as the Homestead and Community Broadcasting Satellite Service, or HACBSS - will perform a dual role. HACBSS is a hybrid form of direct-to-home broadcasting which will also be used to distribute ABC television and radio programs as will be explained later.

With DBS, there are a wide range of policy issues which require very careful consideration. DBS, as is well known, is a new technology which can have major implications for the structure and operation of traditional broadcasting systems. It is the subject of intensive research in many countries.

Some countries are involved in experimental DBS using existing satellites, while others are committed to launching satellite systems specifically designed for DBS in the mid to late 1980's. To the best of my knowledge, no country has yet finalised its policies for the establishment and operation of DBS, except on an experimental basis.

One matter that continues to promote keen debate is that DBS means different things to different people. European countries, the USA and Japan, are interested in high-power satellites capable of providing very high quality pictures to earth stations of less than a metre in diameter. This approach may not be economically feasible for Australia, with our small population spread over a very large area. In any case, these satellites have not yet been demonstrated to have the reliability normally associated with operational systems.

Canada uses the Anik series satellites in an experimental quasi-DBS mode to meet specific broadcasting and telecommunications requirements through medium-power transponders, while retaining the advantages of low cost receiving stations measuring around 1.2 to 1.8 metres in diameter.

Indeed, Australia's proposal to use medium power DBS technology (HACBSS) provides an elegant solution to extending broadcasting services to areas that are currently uneconomic to serve, while complementing existing terrestrial coverage. It represents a rational step towards the era of direct broadcasting in advance of commercially proven use of high-power transponders.

In terms of broadcasting policy, recent research and further cost information reinforces the belief that television and radio services can be extended through the use of satellite broadcasting, to provide services at standards and costs that could be afforded by the majority of communities and

individuals throughout Australia's remote and underserved areas.

The main policy issues raised by DBS services are:

- the possible services, and an assessment of community needs for these services;
- planning, licencing and regulatory matters;
- ownership and control;
- its impact on the broadcasting industry and potential developments such as CTV, STV, Videotex, etc; and
- possible legislative amendments.

6. THE HOMESTEAD AND COMMUNITY BROADCASTING SATELLITE SERVICE (HACBSS)

The Homestead and Community Broadcasting Satellite Service concept within AUSSAT is designed to bring the ABC's radio and television services to underserved areas of Australia. In this application, HACBSS is a form of direct broadcasting (from the satellite directly into remote homesteads or remote communities).

The term HACBSS was coined deliberately to identify the unusual characteristics of this Broadcasting Satellite Service. HACBSS is an amalgam of individual and community reception modes - being intended for individual reception in outback homesteads, but operating at comparatively low flux density more appropriate to community reception (of the order of -115 dBW/m^2) with antenna diameters within the range of 1.2 to 1.8 metres, depending upon the locality.

6.1 HACBSS SERVICE AREAS

HACBSS will use four medium-power (nominal 30 Watt) transponders, concentrated into spot beams. The service intends to broadcast to four distinct areas: Western Australia, including the north-west shelf; Central Australia, covering South Australia and the Northern Territory; Queensland, including the Barrier Reef, and south-eastern Australia covering New South Wales, Victoria, Tasmania, Lord Howe Island and Norfolk Island. (See Figure 1). Because it is not possible to broadcast programs to every state individually through dedicated transponders, a compromise was devised by the system designers which took into account satellite antenna design and time zone criteria.

6.2 THE HYBRID NATURE OF HACBSS

To maximise effective use of the HACBSS, the HACBSS transponders will also be used to relay ABC services throughout Australia, ie: "feeding" the terrestrial transmitting stations in each zone, and thus carrying out some of the fixed satellite functions economically. (See Figure 2). The intention of this arrangement, according to the ABC, is that people living in remote areas would receive

a choice of up to three radio services and one television service per zone, similar to that available to ABC viewers and listeners in metropolitan areas. In the event that people do not purchase individual HACBSS receivers, there will be a need to consider how, and at whose cost, the communities that receive ABC signals via satellite in the community reception mode will distribute them locally. The means of local distribution currently being studied include:

- over-the-air low power re-broadcasting;
- cable reticulation schemes;
- various combinations of the above.

ABC HACBSS (HACBSS 1) is a form of DBS which, by nature of its programming and receiving equipment, will appeal to those living in non-metropolitan areas of Australia. It may find application in more populated areas which, for reasons of local topography, are difficult to serve with good quality terrestrial services. In general terms however, HACBSS 1 does not raise any significant policy issues because most viewers are served effectively by ABC terrestrial transmitters and it is unlikely that a large number of HACBSS terminals would be established outside remote areas.

6.3 ADDITIONAL HACBSS TO REMOTE AND UNDERSERVED AREAS

As well as an evident demand for the fixed satellite service users of AUSSAT and for HACBSS 1 services as a forerunner to direct broadcasting, there is considerable interest in the possibilities for providing additional services to remote and underserved areas via a second HACBSS facility. The system design does provide capacity for a second HACBSS, although this capacity could be used for other purposes, should that service not materialise.

The possibility of additional HACBSS services raises wider policy issues, because, whatever the reason, HACBSS signals will be receivable by major markets throughout Australia.

"Back up" facilities (HACBSS 2) are being provided for the HACBSS 1, and operational advantages will result if these are divided between two satellites located in extreme orbital slots. In effect, HACBSS 1 would use two transponders on the primary spacecraft, and two transponders of the secondary spacecraft. The same approach would be used for HACBSS 2. By this means, a remote homestead in any zone could receive both the HACBSS 1 and HACBSS 2 services on one earth station without repointing. (See Figure 3).

The reliability of modern satellites is such that HACBSS 2 could be used effectively on a pre-emptible basis for other types of broadcasting services, should the Government approve of this approach.



Figure 1: AUSSAT conceptual service areas - orbital location 156°E.

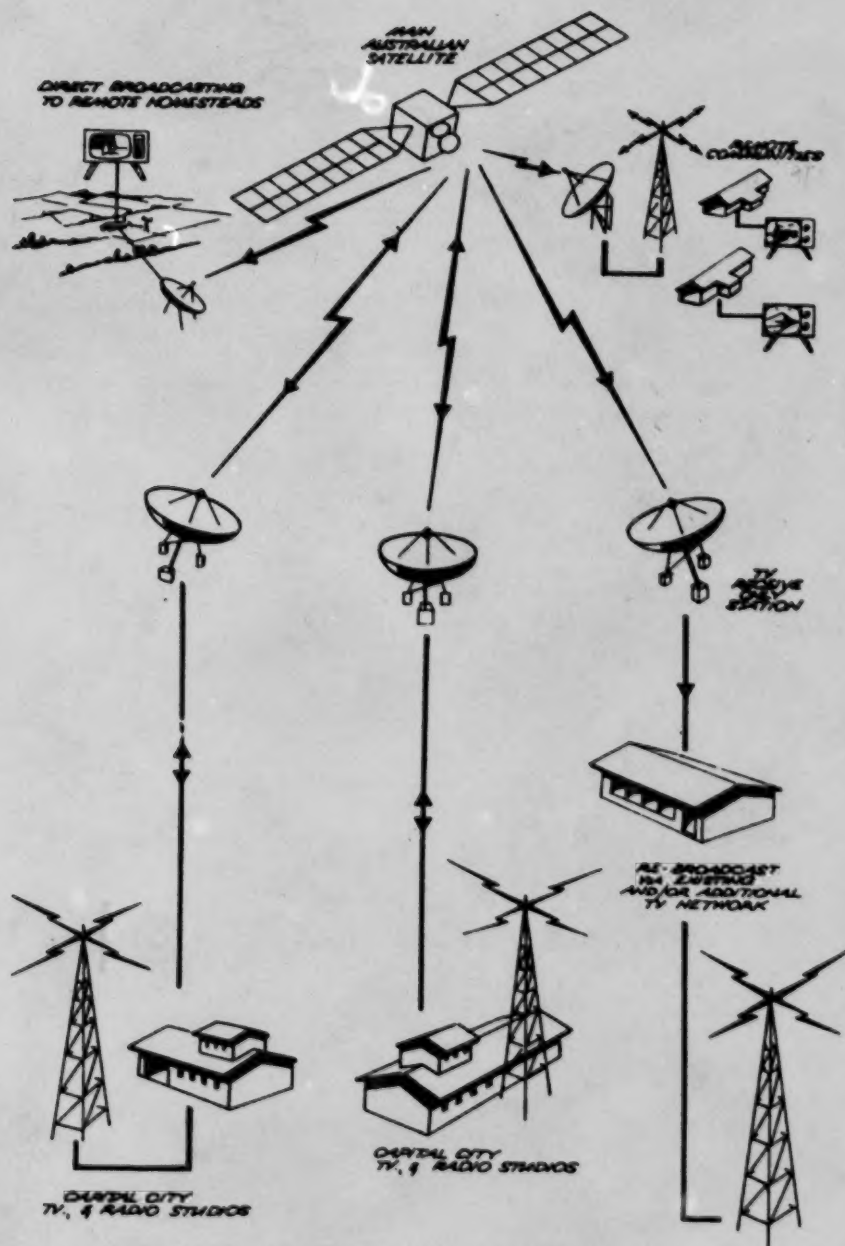


Figure 2: Dual use of AUSSAT for direct broadcasting and relay of signals to remote and underserved regions.

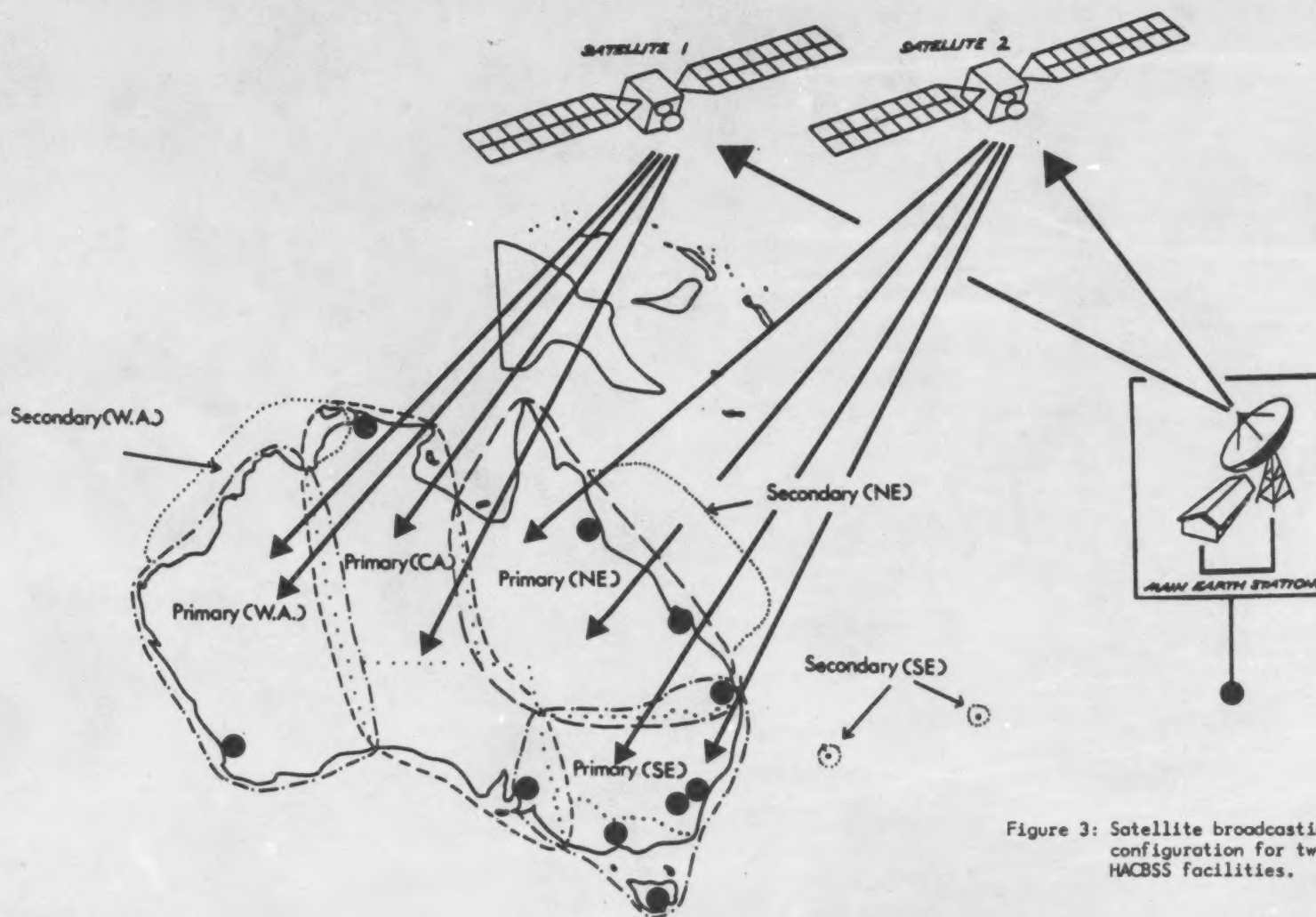


Figure 3: Satellite broadcasting configuration for two HCBSS facilities.

The main commercial television operators, together with other potential broadcasting and non-broadcasting interests, would like exclusive individual use of some or all of these direct broadcasting transponders that will be needed as a back up for ABC services.

The Task Force on Broadcasting Development has therefore suggested a means of using these back up transponders on a developmental basis, to be shared by any interested commercial, public or special purpose broadcasting interests. This concept of a Satellite Broadcasting Development Project is being discussed with the broadcasting industry and a wide range of special interest groups, with enthusiastic response to date.

7. THE SATELLITE BROADCASTING DEVELOPMENT PROJECT (SBDP)

The Task Force's approach is to combine a broad range of uses in a developmental phase, which aims for:

- an innovative approach to direct satellite broadcasting;
- primarily intended to provide remote and underserved communities with a range of broadcasting services on an experimental basis;
- thereby fulfilling demonstrated needs while providing a low-risk environment in which to identify and develop new services;
- at the same time facilitating technical and other experiments in broadcasting planning;
- and involving major consultation with all interested parties;
- leading to an important input to the planning of the second generation AUSSAT system.

I believe it would also provide a unique opportunity:

- to explore the types and range of broadcasting services most appropriate to remote and underserved communities;
- for potential users to gain operational experience of the technology prior to making a permanent commitment to satellite operations, and before the development of a policy for ongoing DBS; and
- to stimulate a demand for satellite receiving equipment, encouraging the involvement of Australian industry.

Each of the four zones could be served by two television and at least four sound channels, but with different program content and different

operators for each zone in a time sharing arrangement embracing national, commercial, multicultural, and special purpose components. (See Figure 4).

The project could operate for a period of, say, five years from the launch date (subject to the life of the 30 Watt transponders) and with continuation of the project beyond this period being subject to later review. The plan calls for a high level of cooperation from all sectors of the broadcasting industry, and other interests, in a way that has never been attempted before. It could be coordinated as follows:

- Overall coordination, including final evaluation and report, by Department of Communications, and advisory board representing participants, or some combination of these.
- Technical coordination, covering all technical arrangements, tests etc. associated with the project; by DOC in association with satellite company AUSSAT Pty Ltd, and industry;
- Consultative coordination, covering consultation at Federal, State and Local Government levels, embracing all of the technical, social and economic aspects of the project.

Detailed consultation and project design would take place in pre-operational years 1982 - 84, with full service beginning after AUSSAT became operational about 1985.

The concept of SBDP is similar to the evolutionary approach preferred by some other countries who have announced plans for direct broadcasting satellite services. It allows us to move forward with a degree of circumspection. I am of the belief that experimentation is fundamental to providing real world answers to some of the basic policy questions confronted by broadcasting planners.

The potential social value and the unproven nature of the project suggests special nurturing, at least in the early stages. But, in order to avoid raising false expectations, and to firmly root the services in reality, it is felt that the proposed service initiatives should be considered from the beginning as likely ongoing (eventually self-sustaining) enterprises.

Discussions are continuing with the broadcasting industry, and other interested parties, and policies on direct broadcasting will be progressively detailed as this developmental approach proceeds.

8. HACBSS SYSTEM DESIGN

8.1 SPACECRAFT DESIGN

The design challenge was to have a spacecraft, based on proven available designs, that met the special Australian dual purpose requirement. In developing a system design based on the requirements of about

Figure 4:

SATELLITE BROADCASTING DEVELOPMENT PROJECT

POSSIBLE CHANNEL UTILISATION IN SINGLE ZONE

SERVICE	Mon	Tues	Wed	Thurs	Fri	Sat	Sun
ABC TV *							
COMMERCIAL TV							
MULTICULTURAL/ SPECIAL PURPOSE TV							
DAYTIME SPECIAL PURPOSE TV							
ABC RADIO *							
ABC RADIO*							
COMMERCIAL RADIO							
SPECIAL PURPOSE RADIO							

* Protected Service - all others unprotected.

30 transponders overall, a balance was required between:

- the provision of HACBSS services - a requirement of two television programs into each service area was envisaged, and higher power is required due to the desire to use inexpensive earth stations, and
- the provision of point-to-point (fixed services) - these being the mainstream of applications and varied in nature.

The resulting 15 transponder satellite design specified in the recent Request For Tender allowed for:

- 4 HACBSS transponders of nominal 30 Watt output power;
- 11 FSS transponders, of nominal 10 - 15 Watt output power;
- EIRP specification (for television)
 - : HACBSS spot beam - 47 dBW minimum
 - : FSS spot beam - 42 dBW "
 - : FSS national beam - 36 dBW "
- Operation of HACBSS in the 12.5 to 12.75 GHz band

8.2 TECHNICAL CHARACTERISTICS OF HACBSS

HACBSS is a concept with several unusual features. First, it operates with a low EIRP in comparison with more usual concepts of Broadcasting Satellite Services in the Ku band, intended for either individual or community reception.

The HACBSS system is intended to operate with a low signal margin to threshold (of the order of 2 dB under clear sky conditions). The environment in the remote areas can be harsh and, in many instances, receivers will be subject to extremes of temperature and, to a more limited extent, cyclonic wind conditions.

On the other hand, the HACBSS receiver is intended to be a relatively simple, low cost consumer item. Given the Government's interest in minimising total system costs for HACBSS, an optimum system can be derived, as shown in Figure 5. It is obvious that the performance cost of the satellite system can be traded off against the expense of receiving equipment, over a wide range.

It should also be noted that rain attenuation has not been considered in the above. Planning of the service has been based on ignoring this factor, as incorporation of adequate margins in G/T would have rendered the service non-viable.

Also note that the operation of HACBSS in the 12.5 to 12.75 GHz band is constrained to power levels somewhat below those possible in the 11.7 to 12.2

GHz band; however, a quite satisfactory service can be provided in the band chosen and the concomitant improvement in system flexibility due to the shared service capability of this band, is valuable.

As mentioned earlier, HACBSS is also intended to encompass sound broadcasting in addition to the television sound signal. The precise technical details of this service are still under consideration. The use of single channel per carrier and sub-carrier techniques has been the subject of continuing research by the Department of Communications with the Canadian Anik B and European Orbital Test Satellite during 1981. It is expected that results will confirm the feasibility of satisfactory reception of a television signal with its associated sound and at least two extra sound broadcasting signals by earth stations 1.2 - 1.5 metres in diameter (assuming the use of 30 Watt transponders).

This would serve some 95 - 98 % of the 300,000 people in Australia who cannot at present receive ABC television, but slightly larger earth stations would be needed by the remaining 2 - 5 % who live on the fringes of the areas that will be covered by the four spot beams. The quality of the HACBSS reception is expected to be better than that of the larger television receive-only earth stations that are currently being used to receive INTELSAT IV's low powered transmissions on an interim basis in a large number of localities (the so-called Remote Area Television Service).

The costs will also be a lot lower. With reasonable production runs, and depending upon the extent of Australian manufacturing content, it is expected that the standard HACBSS earth station should cost the consumer around \$1000 - 1500 in addition to the cost of television and FM sound receivers, and installation charges. This includes the cost of an outdoor unit and an indoor unit connected to it by cable.

It is estimated that there would be a market for about 25,000 HACBSS receivers if there is an ABC HACBSS, while the introduction of a second HACBSS facility could lead to a market throughout Australia of 100,000 receivers or more. It will be a challenge to manufacturers to ensure the provision of sufficient quantities of HACBSS earth stations from the date of launch of AUSSAT.

A pilot quantity of some 100 to 200 HACBSS earth stations will be used by the Department of Communications for field trials during the pre-operational years, and for several months after signals are obtainable from the satellite until commencement of the service. Following evaluation of the service under a wide range of operational conditions, recommendations will be made concerning the receiver performance considered most appropriate for HACBSS.

9. USE OF AUSSAT BY ADJACENT COUNTRIES

The system design makes provision for a likely

SATELLITE BROADCASTING COST TRADE-OFFS

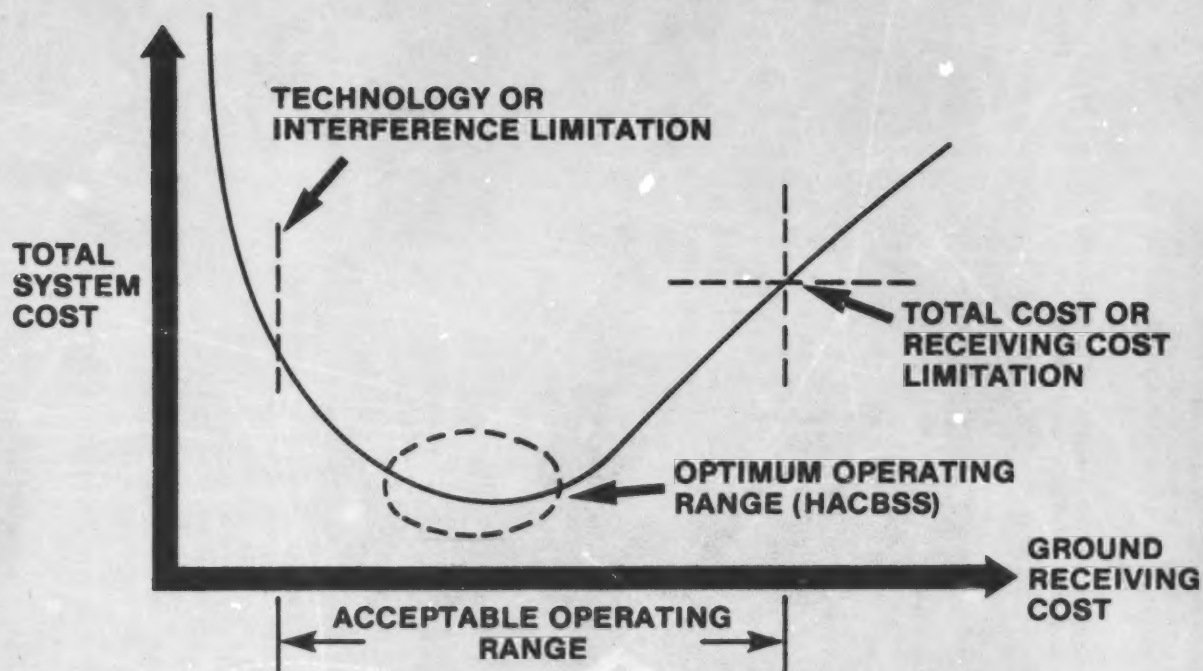


Figure 5: The sum of satellite and earth terminal costs reaches a minimum that varies with system performance requirements.

requirement by the Papua New Guinea Government for the possible distribution of national television services. Coverage of PNG and associated islands will be achieved via a special spot beam into which it will be possible to switch certain FSS and HACBSS transponders if required.

A similar requirement for a number of south-west Pacific nations was carefully considered, but regrettably could not be included in the first generation satellite system without significantly increasing costs and substantially impairing the performance of the planned satellite system.

Recognising the important role that satellite systems can play in the provision of national and international telecommunications for the South Pacific region, however, and mindful of the importance of Australia's relationship with the region, the Government has taken a decision in principle, that planning for the further development of the Australian system should take into account services for the South Pacific countries provided either in later generations of Australian satellites, or in a regional system shared with Australia.

The Australian Government has recently participated and assisted in detailed discussions to identify telecommunications needs of the South Pacific region and how these might be best met through INTELSAT and/or in cooperation with Australia.

10. THE SECOND GENERATION SYSTEM

The long lead times associated with the design and construction of spacecraft, with the scheduling of launches and with procurement processes make it necessary to commence planning for the next generation system at a relatively early stage. This is exacerbated if the second generation system is to have expanded facilities or is to supplement, rather than replace, the first generation system. As a result, planning may need to commence soon after the initial system is brought into use and operational experience may be limited.

Factors which will or may impact on the second generation system include:

- i) The development of direct satellite broadcasting -
 - . is it to be expanded ?
 - . will it move to the 11.7 to 12.2 GHz band?
- ii) Increased demand - will this lead to the need for a higher capacity system and will this capacity increase be all at 12/14 GHz ?
- iii) Possible provision of facilities for the countries of the South West Pacific area, as well as Papua New Guinea.
- iv) Developments at the World Administrative

Radio Conference on Space Services to be held by the ITU in 1984/85.

- v) Improvements in technology, eg: the increase in design freedom available as a result of "Shuttle" launches.
- vi) Provision of new facilities, eg: the possible inclusion of defence or meteorological requirements.

11. ACKNOWLEDGEMENT

The author wishes to acknowledge the contribution of members of the Task Force on Broadcasting Development, and particularly the assistance of Mr. J. Lewis of the ITU, and Mr. R. C. Johnson of OTC(A), in the preparation of this paper.

The permission of the Secretary of the Department of Communications to present this paper is also acknowledged.

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COMMERCIAL SATELLITE COMMUNICATIONS
FOR DEVELOPING AREAS OF THE PACIFIC

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Abstract

The communications requirements of the Trust Territory of the Pacific Islands (TTPI) are uniquely suited for satellite communications. This region contains sparsely populated and geographically spread communities with relatively light communications traffic. High Frequency (HF) radio sporadically links some Pacific Island communities with distant international points, but this system is both inadequate and ineffective. The introduction of high quality commercial satellite communications to the island communities of the Pacific Region promises to advance the area both socially and economically. COMSAT has taken steps to bring modern satellite communication services to the people of the Pacific Basin and progress in many areas will surely be forthcoming.

Communications has long been directly responsible for social and commercial progress of nations. It has in fact revolutionized business and trade, practices, and contributed to the rapid growth and prosperity of developed countries. Early developments of international communications facilities centered mainly along major trading and shipping routes around the world. Undersea telegraph cables in the Pacific Ocean areas were initially installed between 1870 and 1923 followed by higher capacity telephone cables. With the advent of "wireless transmission," in the past 35 years, troposcatter and HF radio techniques have been employed to serve remote and isolated locations where cables were either unavailable or impractical. Thus communication systems evolved in rather sporadic and uncoordinated ways primarily influenced by commercial and trade requirements.

The present communications system in the Trust Territory of the Pacific Islands (TTPI) is a vast network spread over three million square miles of the Pacific Basin. It provides for inter- and intra-island communications, and long haul communications to and from world points using predominantly HF radio augmented by a tropospheric scatter radio link. Services are provided subject to weather conditions, and channel quality is mediocre and erratic. Six major areas in Micronesia—Palau, Yap, Truk, Ponape, Kosrae, and Majuro—operate 5 and 10kW HF radio systems, with nearly one hundred additional outer islands operating smaller 100W HF radio transceivers. Many inherent inefficiencies are imbedded in this system and its use is rather limited and limiting. The limitations of this system stem mostly from its operational and technical parameters as well as transmission characteristics typical to HF radio services.

In order to place routine calls HF radio relay links must be arranged via one of the area Communication Centers. Often these arrangements require prior reservation and involve manual operator coordination at several sites. Due to

traffic routing and signal transmission constraints, communication services are thus awkward and cumbersome.

While the existing system provides an important service, it falls short of meeting the growing communication needs of the Pacific Basin. Newer more flexible and efficient systems—such as satellite communications—have become available for use in conjunction with or in lieu of these HF and tropo-scatter systems.

Let us turn briefly to satellite communications and their promise for modern communications and considerably improved services. President John F. Kennedy's invitation to the nations of the world to cooperate in the development of satellite communications technology in 1961, and the subsequent passage of the Communications Satellite Act of 1962, set the organizational process in motion. The act created the Communications Satellite Corporation (COMSAT) which was formed in 1963 as a privately-owned corporation. COMSAT was charged with a congressionally mandated assignment to create a worldwide satellite network, and to bring the benefits of that technology to the developing as well as the developed nations of the world. Through the concerted initiative of COMSAT, the International Telecommunications Satellite Organization (INTELSAT) was created. And, I note that others on this panel will further elaborate on the INTELSAT system.

Most earth stations built until 1975 were known as INTELSAT Standard A stations. These high-powered earth stations possess at least one 100-foot in diameter (33 meters) or larger antenna which generates a signal powerful enough to make the most efficient use of the satellite's power and bandwidth resources. Such stations are rather complex and cost several million dollars to construct. Costs can vary greatly depending on the amount of traffic the station is expected to carry and the amount of infrastructure development (water, power, terrestrial telecommunications

links, etc.) needed. Being mindful that nations without the traffic and resources of the initial larger members of INTELSAT needed an alternative means for accessing the satellite system, INTELSAT in 1975 approved what is called the Standard B earth station. These Standard B earth stations use antennas which are about one-third the size of Standard A and are less powerful, as well as less expensive to build. Because the transmission signal of these smaller earth stations is weaker it is boosted by the satellite for retransmission, so that the channel quality remains on par with the larger stations. The trade-off is made on the basis of the lower initial capital investment for construction. The establishment of this second standard for earth stations has allowed many smaller nations, including several island nations in the Pacific, to join the Global Satellite system and gain direct access to points around the world. Nearly one-third of the international earth stations today are in fact of the Standard B type.

Currently, the INTELSAT global satellite system in the Pacific, through a single satellite and 32 earth stations, interconnects most of the countries of the Pacific Basin, from Thailand on the west to the West Coast of North America on the east. More progress is being made with plans to construct additional earth stations in major areas of the Pacific.

Recognizing the shortcomings mentioned earlier in the present inter-island communications system and the growing communication requirements of the region, COMSAT began discussion with the Trust Territory Government and the U.S. Department of Interior in the mid-1970's. Joint and cooperative efforts and supportive encouragements have led to the creation of practical approaches on how to best serve the unique communications requirements of the region. Our experience in this regard will be briefly highlighted in the following paragraphs.

Traditionally we analyze historical communication usage and traffic trends in order to project the communication requirements of developed areas. This typical approach turns out to be quite misleading, and falls short of providing a true indication of communication demands for new and developing areas. Such was the case in American Samoa when COMSAT first investigated the feasibility of constructing and operating a Standard B satellite communications earth station. Initial forecasts indicated requirements below the level needed to justify a feasible investment. Since commencing service to Samoa in 1979 we have gained valuable first-hand experience. The original five years traffic forecast of 25 circuits was in fact exceeded after nine months of operating! By 1983 it is forecast that the total channels in service in American Samoa will be 63. In addition to voice and message communications, high quality television programming reception services are also available. In a survey conducted following the first year of operation in American Samoa 96% of

all respondents considered satellite service as a definite qualitative improvement.

Thus, initial justification for earth station investments is misleading and difficult. We occasionally use the analogy of two towns with a poor road connecting them, and therefore with little traffic between them. Once a road is built, traffic is established and the communities at each end thrive and prosper and realize socio-economic growth. Indeed, such is often the case with a new communication facility which tends to act as a catalyst to progress in many areas and thereby creates an increased demand for communications and so on. We believe that communications begets communications.

Following American Samoa, the Northern Marianas was the first of the Micronesian locations to begin communicating via satellite. The COMSAT earth station in Susupe, Saipan, was inaugurated in November of 1980 and began operation 10 circuits. By the end of 1981 there were 17 circuits emanating from the Saipan earth station; usage in the high quality and reliable satellite service is continuing to increase and user satisfaction is most evident.

The next earth station we plan to construct in Micronesia is in Palau on the island of Koror, and operation is expected in mid-1982. Additionally, COMSAT has signed agreements and filed with the FCC for authority to construct and operate earth stations on six additional major islands in the Pacific Basin. Over the next few years COMSAT plans—pending FCC authorization—to construct earth stations and commence satellite communication services in the four major islands of the Federal State of Micronesia (FSM)—Yap, Truk, Ponape and Kosrae—as well as in the Marshall Islands—Majuro and Kwajalein (Ebeye). Interconnectivity will be established between communities of interest among these islands as well as to Guam, Hawaii, Japan and the U.S. mainland. Additional points in the Pacific area may be added to expand direct service as required. (A map of the Pacific region satellite system showing COMSAT's existing and planned earth stations appears at the end of this paper.)

It is most important to note that while the political status of the islands in the Pacific Trust Territory may change and they may become independent, freely associated or integrated territories, their communications capability through the INTELSAT system will not be affected. This eventuality was specifically provided for in COMSAT's contractual agreements with each local government and the FCC authorizations necessary for COMSAT to own and operate the earth stations. Thus the present and future communication needs of the region were considered comprehensively from technical, operational, business and political points of view.

It is important to note that the local

distribution systems are being provided by the local governments. While modern inter-island communications is a major step, its usefulness is quite dependent on the local telephone and switching plant and the intra-island distribution network.

Investigations are now underway to define the most suitable approach for serving even smaller outer islands, particularly in the Pacific. We are assessing the feasibility of small earth stations with perhaps a handful of channels for very low traffic requirements of Pacific island communities. It is envisioned that many hundreds, perhaps thousands, of isolated communities may be linked via satellite within the next decade.

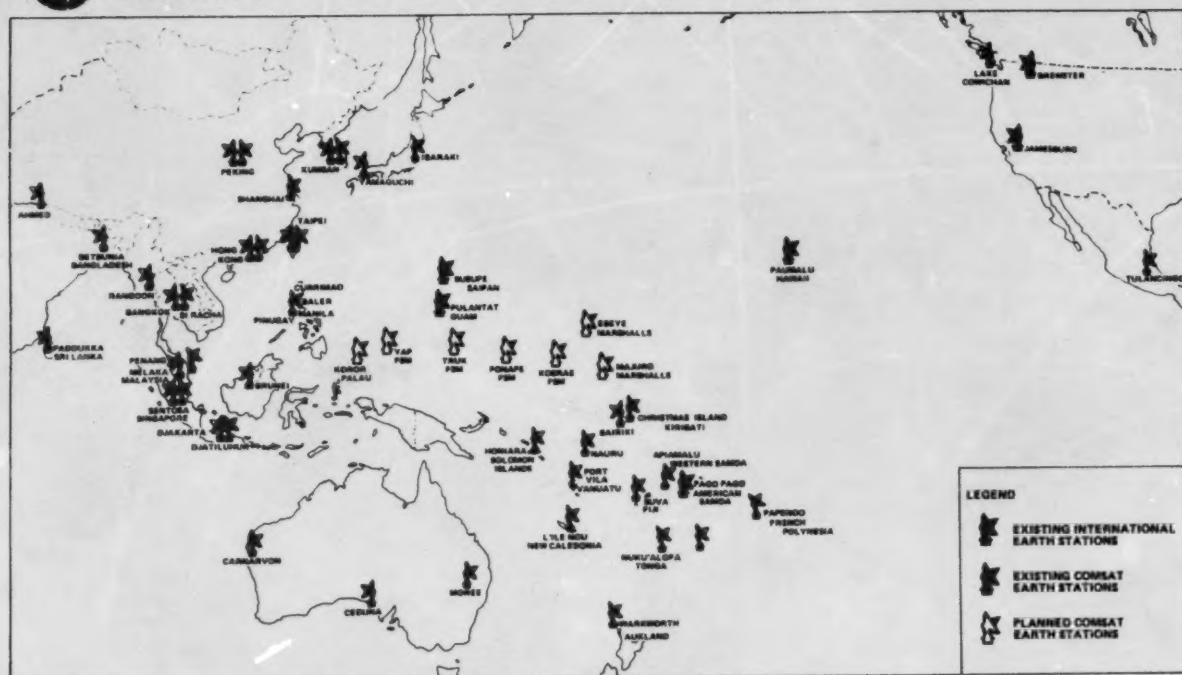
COMSAT is proud to have the opportunity to serve the communication needs of the people of the Pacific Basin. As the representative to the United States from the Northern Marianas Edward Pangelinan noted at the dedication ceremony of the Saipan earth station: "This new earth station will provide a vital link between local government and communities on matters affecting the people of the region. Now the rest of the world is just a quick phone call away."

We certainly look forward to a productive business relationship with the people of Micronesia, and believe that satellite communication is a bridge to the region's progress and prosperity.



COMSAT
WORLD SYSTEMS

PACIFIC REGION INTELSAT SATELLITE SYSTEM: 1981



COMMUNICATION TECHNOLOGY: PLANNING OR PROMOTION?

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1. Abstract

Communication technology has become a fashionable commodity caught up in a wave of aggressive promotion in international markets. In this environment, technology assessment and planning is enormously biased. The problem is compounded by the imbalance in assessment criteria between technical/economic factors and social/cultural/human factors. An enlarged framework for technological assessment is suggested that will slow the rate of technological change, but reduce the risk of unintended technological fall-out.

2. INTRODUCTION

Communication technology has the potential to revolutionize society. Fundamental alterations of information flows and patterns of communications will bring significant changes in economic, political, social, and cultural relations. Indeed, H.A. Innis observed some 30 years ago:

"We can perhaps assume that the use of a medium of communication over a long period will to some extent determine the character of knowledge to be communicated and suggest that its pervasive influence will eventually create a civilization in which life and flexibility will become exceedingly difficult to maintain and that the advantages of a new medium will become such as to lead to the emergence of a new civilization." (1)

To date, the modern communication technologies (satellites, digital transmission, computer data banks, high capacity cable, fancy terminal devices, etc.) have been implemented primarily, although not exclusively, in the so-called technologically advanced, industrialized nations. At the present time, organizations and individuals with a vested interest in the expansion of communication technology stand poised, ready to descend upon the rest of the world to bestow upon it the benefits of the newest communication technologies. But what are the implications? Is communication technology being implemented after assessment of its implications in a planned direction, or has it become the fashionable commodity adapted for promotion and sale by the technologically-advanced nations and the multinational corporations in international markets that are subject to increasingly tense competition and more and more aggressive promotion? In this environment, the desirable objective of planning and assessment may well become impossible.

3. THE CHARACTERISTICS OF TECHNOLOGY PLANNING

Today, there are many people and organizations involved in communications technology planning. Substantial amounts of economic resources, and powerful and sophisticated tools of analysis are brought to bear in creating communication

technologies, in evaluating the technical aspects of new technological opportunities and in assessing the costs of financing their implementation. Relatively short-term assessments of economic benefit/cost consequences are sometimes made. Experimentation on different types of use and specified short-term effects is undertaken. Long-term social, cultural, and individual human effects remain too speculative, qualitative, general and vague to consider seriously within the framework of existing modes of analysis.

Given this state of affairs, is it reasonable to expect that the introduction of new communication technologies, and the extension of communication systems and networks will have unintended detrimental consequences for major segments of society, including the obliteration of some cultures and the homogenization of others? How great a risk is it to implement all advances in communication technology when methods for assessing long-term cultural, social and human consequences do not exist?

I submit that the risks are higher than is generally thought, and increasing. They are made high by: the enormous significance that telecommunication systems are coming to play in the lives of people in more and more countries; the fact that communication technology has become institutionalized, and has acquired powerful vested interests and is virtually on a runaway course of promotional market expansion; and by the imbalance in criteria used for planning, implementing, evaluating and marketing communication technologies.

We are well aware that virtually all technologies have had unintended harmful effects. The great plans and promises surrounding the "green revolution" in agriculture—the introduction into developing countries of the technology of American farming, including equipment, pesticides, fertilizers, education and information—have floundered, for the most part, as the longer-term social and human consequences have begun to work themselves out. Should we expect anything different from the communications revolution? What can be done to avoid, or at least to minimize, the possibilities of unintended long-term cultural, social, and human consequences?

4. ENLARGING THE FRAMEWORK FOR TECHNOLOGICAL ASSESSMENT

It is traditional to categorize the study of communication systems into four major areas: technical, economic, social and personal or human. The political area cuts across all of these in determining communication policies. The stated purpose of virtually all advances in communication technology is to better serve human and social communication needs. Economic and technical factors come into the analysis as constraints. The extent to which needs can be satisfied is limited by the economic resources that are required and the technical capabilities. The first level barrier must be the technical one; without the technology, certain communication opportunities are simply impossible. The second level barrier is the economic one; if the technology is to be implemented, the costs must be affordable to some organization or government willing and able to pursue the adventure.

Only when these two sizable hurdles have been jumped do we find ourselves confronting the issues of social, cultural and human implications. These assessments come after the technology has been innovated and made economically feasible, and after it has developed a self-justifying momentum of its own. In most cases, by then it is too late for realistic evaluations that can result in major system modifications. Thus, most technological assessments, environmental impact and other such studies tend to be superficial and simply delay the introduction of technology.

In technical terms, developments in communication have been enormously successful. Reflecting past success and future promise, communication research and development and related activities commands increasing quantities of resources both from private companies and government agencies. As Western society moves toward the full integration of communication and computer technologies, it is reasonable to expect this wave to keep growing. And it is being pushed by an ever larger and more powerful constituency of vested interests. It seems clear that new technological opportunities will continue to appear at a rate that is substantially greater than any experience the world has known. As part of this technical analysis, any consideration of long-term potential social, cultural and human consequences is extremely small or non-existent. These factors are not part of technical research and development, or of today's market economics.

This trend of events is leading us down a path where greatly increased professional attention and funding is being directed to the technical and narrow economic aspects of technological development. The analysis of technology is tending to optimize the technical aspects, to move toward optimizing the narrow economic aspects and to forget the larger cultural, social and human aspects that the technology ultimately is supposed

to serve. Moreover, the imbalance between the technical/economic factors on the one hand, and the social/cultural/human on the other is becoming greater and greater.

This failure to consider the total system affected by the communication technology and to place increased emphasis upon sub-optimization of the technical and narrow economic components must increase the risk of detrimental fall-out in the areas of social, cultural and human consequences. Communication technology has not yet been charged with a major ignominious failure prompted by unforeseen social and human effects--although many critics of television and researcher documenting the destruction of native cultures would dispute this--largely because insufficient time has passed to fully assess its implications. As the technology becomes more pervasive in our lives, as this imbalance favouring the technical/economic factors becomes greater and the sub-optimization continues, the risks must increase.

Improvement in the process of technological evaluation to consider cultural, social and human factors must come at the initial planning stage. The analysis of cultural, social and human "needs" must go beyond the simple assumption that the only matter of concern is the creation of a system that will allow information to be transmitted economically.

At present, relatively little information is known about possible cultural, social and human consequences of new technology that could be incorporated into the technology planning process. One reason for this problem is because of overspecialization with the professional discipline and lack of effective communication among them. Technology planning must become transdisciplinary and include the contribution of many disciplines on a continuing basis. If the planning process is restructured in this manner, the direction of technological change may be modified to reflect these broader consideration.

Under this approach, one would expect that at least some of the important cultural, social and human issues that, at present, are raised only after the fact would be considered before the basic design of the technology is set. These would include such matters as: consideration of the probable character of personal interaction with different communication media over short and long-term periods; the unique characteristics of different communication technologies in fulfilling human needs, i.e., a recognition of the qualitative differences in technologies as measured in social and human terms; the transparency of the medium in transmitting messages that are free from distortion, or that are inherently distorted or biased in certain ways by the medium; the context in which the technology is likely to be used and its relationship to other human and social activities. Issues such as information overload, access to information and to communication, and the

significance of gatekeeping functions in our new world of manufactured information hopefully would be raised and considered at the level of technological planning.

What this approach to technological planning means is a deliberate sacrificing of some technical and economic opportunities to reflect consideration of cultural, social and human factors. Not all potentially profitable technological opportunities would be pursued. There would be more study throughout the process of technological development and probably a somewhat slower rate of technological change.

This approach reflects an attempt to get the actual innovation process closer to the path that is so often used to rationalize it, i.e., responding to social and human needs. It confronts the apparently autonomous and deterministic characteristics of the process of technological development in communications and attempts to alter that process to make it at least partially variable in response to cultural, social and human needs as best they can be considered.

5. CONCLUSION

One should not be terribly optimistic about the short-term contributions of a change in the technology planning process as outlined here, especially in light of the powerful vested interests with incentives to prevent its implementation. However, hopefully it would set a course for planning that would stretch the intellectual horizons of hide-bound engineers, economists, sociologists and psychologists beyond their artificially defined disciplines and generate more useful knowledge about human, social and cultural communication processes than we have known in the past. It would provide no guarantees, but it would reduce the risk of unintended harmful technological fall-out.

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Future
Telecommunications
Systems and
Services:
Policy and Planning
Considerations

One Third of the World: A Review of
Pacific Islands Telecommunications Requirements

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Abstract

This paper describes the Pacific Basin Communications Study, an assessment of Pacific islands telecommunications requirements, recently completed by the Public Service Satellite Consortium under contract with the National Aeronautics and Space Administration (NASA). The study describes extant and planned telecommunications systems in the region, examines user needs in terms of the development of governmental, social and commercial activities and proposes and describes alternative technological solutions to communications problems. Questions of financing, implementation, management, costs and benefits of a regional telecommunications system are discussed. This paper describes user requirements based on six months of field investigation and technological options for improving telecommunications in the Pacific islands.

INTRODUCTION

The Pacific islands lie in an ocean that covers one third of the earth's surface. The islands that dot the Pacific have little land and limited land-based resources for supporting their small, far-flung communities. The distance between island entities, their sparse populations and their limited development all contribute to an urgent need for improved national and regional communications systems. Nearly every country and territory in the Pacific is linked internationally by satellite through INTEL-SAT, but domestic communications facilities range from adequate in some urban areas to non-existent in unserved rural areas.

A series of events has led to the study on which this paper is based. Following nearly a decade of interest by the Pacific Forum of prime ministers in improving telecommunications in the Pacific islands, in 1980, the Forum directed the South Pacific Bureau for Economic Cooperation (SPEC) to advise potential providers of satellite space segment that Pacific islands countries would be interested in sharing satellite use with them.

Also, NASA wanted to investigate 1) follow-on options to ATS-1, recognizing that the satellite's heroic durability was waning, 2) requirements in the region that could be served by satellites in the 30/20 GHz band and 3) the possibility that a cooperative project with Canada involving mobile satellite communications might benefit Pacific islands users.

Thus, in 1980, NASA and the National Telecommunications and Information Administration of the U.S. Department of Commerce funded the Pacific Basin Communications Study in which the Public Service Satellite Consortium describes and assesses the telecommunications requirements in the Pacific islands. The final report, in two volumes, was released in October, 1981.

It is common practice to describe needs as they are recognized in the most general terms. PSSC found it was, in addition, imperative to ask users of telecommunications systems how the state of communications in their country affects the work they are engaged in and generally how communications relates to national development. Only with such information in hand can engineers choose from a series of technological options and design a system which is appropriate for Pacific islands use.

THE PROJECT TEAM

The project team, made up of PSSC staff and engineering and social science consultants, conducted a literature survey of extant and planned Pacific islands telecommunications systems using information contained primarily in the University of Hawaii's Pacific Collection and the International Telecommunication Union's South Pacific Regional Telecommunications Development Project in Suva, Fiji. During the first half of 1981, the team visited 13 island entities and asked telecommunications officials to verify the data from the literature search before meeting with government personnel, traditional and elected leaders and villagers in order to document the fact that the disequilibrium in the delivery of goods and services to the rural and urban areas of a country creates a gap in development between the two sectors. Finally, the team sought to determine the affect of telecommunications on national development.

While the team visited American Samoa, Western Samoa, the Cook Islands, Niue, Tonga, Fiji, Vanuatu, the Solomon Islands, Papua New Guinea, the Federated States of Micronesia, Belau, Guam and Nauru, the definition of the Pacific Basin used by PSSC includes the islands of Melanesia, Micronesia and Polynesia and excludes Australia and New Zealand except wherein their policies affect the Pacific islands.

COUNTRY VISITS

Recognizing that reliable telecommunications is an essential element of integrated rural development, the project team organized the country visits to ascertain the way in which the current status of communications affects the work of government officials in such sectors as agriculture, education, fisheries, planning, health, law enforcement and disaster relief. The team further explored how telecommunications affects the lives of such other potential users as traditional leaders, churches, women's organizations, local councils and young people. Visits to rural communities and remote outer islands provided a view of a sector of society rarely touched by the quality, and certainly the rapidity, of development from which more urban populations benefit. Without improved development in rural communities, national development is seriously jeopardized.

The new nations of the Pacific are not easily unified. Provincial authorities' perceptions differ widely from those of central government officials. The development of national identity, human resources and economic resources are affected by the state of telecommunications and improved telecommunications is an absolute requirement in order to clarify the objectives of policy-makers and to equalize their goals. Among the issues which recurred in discussions throughout the Pacific, the following were pervasive in terms of the affect of telecommunications (or its lack) on development in the region.

ISOLATION

Isolation caused by inadequate transportation and communication between rural and urban communities results in a sense of powerlessness for rural inhabitants who come to believe that they are not entitled to the kinds of services town dwellers take for granted. In the extreme example, people in the rural environment come to accept death as the inevitable consequence of major illness or injury, even as they recognize that the threat or consequences are hardly the same for urban people.

BROADCAST RADIO

Broadcast radio, which serves to compensate for the lack of adequate, far-reaching two way voice and data service to rural and outer island communities, is the primary means of minimizing isolation in the Pacific islands.

In several countries, parliamentary sessions are broadcast. In the Cook Islands, Parliament has been known to adjourn when technical difficulties have interrupted broadcasting of a session. In the Solomons Parliament is broadcast by law, as an inalienable right of the nation's people. Yet, the notion is unknown in Papua New Guinea, and in the Kingdom of Tonga, where stability is not at issue, only the opening and closing of legislative sessions is heard on the radio.

Service messages are short, typically paid, personal announcements of interest to a particular individual, family or community with little other communications access. The most common service messages are birth, death and marriage notices, birthday and festival announcements, requests for individuals to contact government departments and messages of unique personal concern. People are said to tailor their time to be free to listen to these messages which are usually broadcast in the language most easily understood by the communities surrounding the person to be reached, regardless of the language of that individual.

In the Solomon Islands thirty percent of service messages are from the government. The provincial headquarters of the island of Malaita spends \$400 monthly on service messages that are sent by letter or telegram to Honiara, the capital, on the island of Guadalcanal, to be broadcast by radio to reach remote areas of Malaita.

Government departments and churches use broadcast radio regularly to distribute schedules of visiting teams, harvest information, marketing news, training opportunities, etc. Thirty second radio spots on important issues in health, agriculture and education have been developed on the model of a Western commercial. Radio assists with the announcement of both ships and air traffic. Points of origin, destinations and arrival and departure time of all international and most domestic flights are announced in most countries.

Broadcast radio is vital in emergencies. Radio stations are not shut down during hurricanes. One station manager recalled a time when the station operated continuously for four weeks. Although providing public safety services--disaster warning, emergency relief, law enforcement--is seen as a basic service required of governments, it is beyond the reach of many Pacific islands because the telecommunications infrastructure required to ensure the functioning of such capability are not currently in place. Reliance on broadcast radio is currently a major factor in public safety.

Broadcast radio is popular; it fends off boredom while minimizing isolation. People listen to radio because it entertains while it educates, informs and contributes to national unity.

TRANSPORTATION AS COMMUNICATION

Response to the question, "What kind of communications do you have outside the major towns?" frequently included such details as "roads, some trucks, canoes, motor boats and some air flights. In national development plans, road systems typically are included in descriptions of "communications." Where telecommunications development is limited, transportation is the only alternative means of connecting, of creating accessibility between rural and urban communities. In most of the Pacific, transportation bridges the communications gap and is the primary vehicle for interaction.

Other sectors, such as health, agriculture and fisheries, which depend on both transportation and communication do not view them separately because neither is sufficiently well developed or integrated to meet the society's needs. Combining the two serves to compensate for the deficiencies of each in providing vital connections for those who need to communicate.

TOWARD SELF-SUFFICIENCY: IMPORT SUBSTITUTION, COOPERATIVES AND MARKETING BOARDS

In interviews, leaders of Pacific islands government departments repeatedly said that economic self-sufficiency is the key ingredient of national stability. Import substitution, particularly in food, is often cited as a key development goal, and in some countries the level of production in some items is sufficient to allow export. But the full development of marketing systems, particularly in widely separated Pacific islands, depends on adequate transportation and communications infrastructures.

A chief marketing problem is that intra-regional trade is difficult because of the similarity of commodities in the countries of the region. Yet, there is far more room for regional trade than currently exists. Only with improved communications links--both voice and data--and adequate shipping, can the countries gain a better grasp of each others' specific requirements and their own ability to meet the region's needs.

A number of Pacific countries are establishing marketing cooperatives to encourage rural farmers in cash crop production and to bring down the price of goods available to rural people. Government established copra, coffee, cocoa and palm oil boards serve as regulating authorities, set standards for products and serve as collecting agencies. Some cooperative authorities express frustration in trying to establish well run cooperatives without the assistance of a communications infrastructure. They point particularly to the difficulties of managing the collection and sale of products without adequate communications.

In some countries commodities boards take on some of the functions of cooperatives, acting as middle men between the farmer and wholesaler. The weakest links are between the cooperative and farmers and between mobile buyers and officers. There is an expressed need for trucks to have two-way radios to be kept informed of market prices and to keep officers informed of incoming goods to enable the encouragement of timely sale of perishable items.

Broadcast radio is often the only means of informing farmers of the arrival dates of copra collecting vessels. If no one in a village has listened at the proper time, or if atmospheric conditions have interfered with reception, copra boats may arrive to find that no copra has been readied for shipment. That failure, in turn, leaves farmers without one immediate cash income provided by the copra buyer who may not return for several months.

AGRICULTURE, FISHERIES AND TOURISM

Agriculture, especially in rural areas of remote provinces, is a source of growing revenue throughout the Pacific. Agriculturalists in the Solomons cite "getting from place to place and having regular access to telecommunications facilities" as the primary obstacles to their work. Extension workers who want to communicate with central offices--whether agriculture, forestry, fisheries, minerals, management or surveying--must leave their tasks and travel miles and often hours to a fixed radio to speak on a fixed schedule, or to a pre-booked non-fixed scheduled call. The allotted time is often too short to accommodate ordering, clarifications, and the answers to specific questions. Typically, a 15 to 30 minute exchange involves voice communication among several dozen people. At best, the system is unwieldy; at worst it is described by users as worse than no communication at all.

The development of fisheries is considered essential to economic survival in a number of Pacific islands nations. Yet, authorities note that improvement of telecommunications is essential for the management of fishing, both in terms of the licensing and monitoring of foreign fishing vessels and in tracking migratory species, inventorying catch, processing and marketing. One Micronesian official noted, "Communications is critical because fishing is so competitive. To be world class, we must have communications."

Currently, when there is shipboard radio, contact with shore or other ships typically must be made through the post and telecommunications authority. Information on catch, fishing boat location and marketing could be conveyed more conveniently and rapidly, according to fisheries personnel, if they were able to make direct contact with fishing boats.

Although government leaders are certain that tourism is a highly profitable income-generating industry, its impact on other island societies such as Hawaii and the Caribbean nations has been extreme, and its introduction in the Pacific is too recent for policy-makers yet to determine whether the liabilities of its affects are offset by the advantages. Whether large-scale or small and selective, tourism's development requires a certain level of infrastructure development to facilitate necessary air and hotel bookings. People are reluctant to travel without the assurance of confirmed transportation and lodging, and improved communications are also required to assure travelers a reasonable supply of goods and services. Without adequate communications, supply is uneven and it is a major chore to keep available items promised on a printed menu.

No matter what kind of tourism a nation chooses to develop the benefits from employment opportunities and the spreading of transportation and communications infrastructures to new areas can contribute to the national good. A minimum reliable communications system is essential.

TRAINING AND PERSONNEL

The development of a cadre of professionally competent technicians, engineers and managing administrators is crucial for the implementation of a reliable telecommunications system. Small populations have difficulty producing sufficient numbers of adequately and appropriately trained personnel for the many varied jobs that are vital to the building of a nation.

Those who are trained, whether locally or abroad, take jobs from which they are then plucked before they have had time to gain expertise and confidence in their professional roles. They are catapulted into managerial positions for which they are ill prepared; they know well neither the skills of their former jobs nor those of management. Worst of all, they are ill prepared to train those who come up through the work force seeking role models and specific training from them.

The resulting professional isolation leaves the employee with no one else to talk to who knows how to do the same thing. There is little collegial camaraderie; there is no source of second opinion; there is no security-engendering support from others like oneself. Reliance on expatriates perpetuates this cycle from which local professionals cannot break. Careful planning on the part of central administrative planning departments, the management of each government department and the private sector is required in order for sufficient numbers of appropriately trained people to take on the roles required in the pursuit and achievement of national development.

CONCLUSIONS DRAWN FROM COUNTRY VISITS

Discussions with scores of individuals in over a dozen countries in the Pacific revealed a pervasive sense of frustration with the rate of development caused by an inability to communicate. Examples provided in both urban and rural environments document the fact that without an adequate, reliable, maintenance-simple and affordable telecommunications system integrated national development in all sectors is nearly impossible to achieve.

TECHNOLOGICAL OPTIONS FOR IMPROVED COMMUNICATIONS

During the country visits, technical, traffic and social data was fed back to engineers in Denver and Washington, D.C. who examined alternative means of providing improved telecommunications region-wide in the Pacific. A series of technological options including fiber optic cables, meteor bursts, high frequency, very high frequency and ultra high frequency radio, tropospheric scatter, constant altitude balloon repeaters and satellite was examined in an effort to find a technology which would provide a reliable, maintenance-simple and affordable system. It became apparent that great improvements are unlikely on a nation by nation basis because costs are great, and island economies limited. International cooperation within the region, therefore, is seen as extremely critical. To meet the wide variety of unique telecommunications require-

ments of each nation of the region, the study recommends an integrated communications system which would allow for sufficient utilization across the region to be economically attractive.

A broad range of telecommunications technologies was examined in order to determine which of these, singly, or in combination, would best provide the communications requirements of the Pacific islands.

At a SPEC/PSSC co-convened meeting of users from ten island nations, in Suva, in June of 1981, participants stressed that any newly proposed system would have to build on the communications systems already in place since it would be far too expensive and unwise to try to start from scratch or replace equipment that represented substantial investment on the part of a national government, especially when such equipment is already familiar to telecommunications personnel and users alike.

Satellite was seen as the only sufficiently flexible technology to meet the requirements that had been documented throughout the region.

INTERIM SYSTEM

The study recommends interim use of existing or proposed satellites such as the Australian domestic satellite (AUSSAT), INMARSAT, PALAPA, TDRS, and ALASCOM. Investigation of these possibilities is currently underway. A second alternative would be the extension of the present INTELSAT system, including provision of small, low-cost earth stations in remote locations that would serve to relay local communications, operating in conjunction with the existing standard A and B stations. INTELSAT's keen interest in this part of the world may result in their creating special regional tariffs; they are currently negotiating special rates for the users of ATS-1 which has served the Pacific for nearly a decade but whose life span and support are finite.

INTEGRATED COMMUNICATIONS SYSTEM

The study recommends the creation of an integrated communications system, and points to a 2.5 GHz satellite as best equipped to meet the greatest number of needs for the most nations. It is not, however, the only option. In the tropical environment on which the study focuses, rain attenuation obliterates the Ku band option; during hurricanes, when communications are imperative, there would be none. C band (6/4 GHz) makes no allowance for mobile use which is of basic importance to the Pacific community.

A hybrid system then, might be the ideal solution to Pacific islands needs if costs could be kept down. Capacity would be greater than with S band alone, and although the ground segment would be more expensive, costs could be counterbalanced by the increased traffic capacity of the C band configuration. Without knowing the precise characteristics of each system that might be put in place for the region, it is not possible to give precise estimates of cost.

MANAGEMENT

In the Pacific there are reasons to believe that a regional approach may be more productive in the provision of additional telecommunications capacity than a national one. The shared use of facilities would result in a lower cost per user because of economies of scale. But because the various island entities have different political status and affiliations, the creation of a regional system requires some creativity. Taking for granted that those portions of the system that fall within national boundaries would continue to be administered as at present, the study proposes four possible management structures for the integrated communications system:

- 1) Manager country -- a single nation in the region acts as administrator and manager of the regional portion of the telecommunications system.
- 2) Private corporation -- a new corporation, established by countries in the Pacific Basin, acts as purchaser and central manager of services for all participating countries.
- 3) New regional consortium -- a new entity with membership from all users acts as administrator and manager.
- 4) Existing entity (e.g., SPEC) acts as administrator and manager and obtains contractual agreements from non-member countries desiring to share the system.

Regardless of the choice, support and endorsement from countries in the region and existing regional consortia would be required for successful development of a regional communications system.

WHO WILL PAY?

Regardless of how improved communications are brought into the Pacific islands nations, there will be capital expenditures and on-going operational support will be required. A growing body of studies tends to suggest that telecommunications systems can, even in developing countries, generate respectable rates of return on the initial investment. When one is looking at the Pacific, there is a common assumption that these countries, even in the aggregate, are "too poor" to be able to afford better communications. Until more detailed analyses are performed on a country by country basis and with a well defined communications system in mind, it will be impossible to show conclusively that the system can be made to pay. Fortunately, we can find data from projects in other developing countries and regions that provide at least some guidance in terms of questions about funding of new systems.

While it may be safe to assume that a developing country or region can generate internally some of the funds needed to establish a new or improved telecommunications system, the order of magnitude of investment required for, e.g., a new satellite, will clearly extend beyond the limited resources

of the Pacific islands region.

If a system is chosen such as the integrated communications system described in the Pacific Basin Communications Study, involving a new satellite and augmentation of existing communications facilities in each of the island nations, the chief cost barrier will be the approximately \$100 million required to build and launch the satellite. While it might be assumed that capital from the countries might be generated in sufficient volume for them to make, in effect, a down payment on the system of, perhaps, ten percent of the cost, clearly other sources of funds will be needed. Among these could be supplier credits, foreign commercial banks, bilateral donors, multilateral development banks, and the United States Development Programme.

It will likely be in the interest of certain of the developed countries that have relationships with the Pacific islands nations, e.g., Australia, New Zealand, the United States, France and Japan, to provide low-interest, long-term loans for the purpose of capitalizing the satellite system.

If as a rough estimate it can be assumed that these affiliated, developed countries would assume 50 to 60 percent of the nonrecurring costs of putting a satellite system in place, then a remaining 30 to 40 percent of the funding required would have to be sought from other available sources.

Such entities as foundations, system suppliers and private investors may find it in their interests to support Pacific telecommunications projects. Whether through gifts, grants, loans or credits, support from this sector might be as much as 10 percent of the initial capital costs.

Finally, while the World Bank considers itself the lender of last resort, it has been the principal multilateral source of financing for telecommunications development in developing countries. The Bank may be disposed to working with one representative of the various Pacific islands users.

EARTH STATIONS

Whichever system is selected, and however it is funded, at least 3000 (possibly as many as 6000) earth stations will be required to provide voice and message service to major population centers, rural areas of large islands, and individual outer islands throughout the Pacific. As stated above, earth stations must be affordable, easy to maintain, easy to relocate, sturdy in the face of a tropical climate, and require a minimum of power.

CONTINUED RESEARCH

By drawing from available technological options and investigating economic models for rate of return on investments in telecommunications, in the coming year, PSSC will continue to refine its recommendations for improved telecommunications in the Pacific islands. Further, PSSC will maintain contact with Pacific islands governments, regional

organizations such as SPEC and the South Pacific Commission, representatives from such international organizations as the UNDP and the European Economic Community, international lending institutions, manufacturers, INTELSAT, metropolitan countries with interests and responsibilities in the Pacific, and interested agencies and departments of the United States government, in order to continue to explore appropriate means of improving telecommunications in the Pacific islands region.

Network New Zealand:
A Policy Research Study on the Future of
Communications in New Zealand

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1. ABSTRACT

The paper describes the work of a policy research group set up by the New Zealand Commission for the Future to identify the major trends in the development of communications and information over the next 30 years and to consider the likely impact of these on New Zealand. The place of future studies in the overall planning process is described and the author outlines the approach taken by the policy research group to its task which involved consideration of communication needs, social values, communication goals, technical developments and policy alternatives. The paper summarizes some of the key findings of the policy research group.

2.0 INTRODUCTION

It is now widely accepted that the future will be dominated by the technologies of computers and telecommunications. These are merging into what are becoming known as the information technologies. It is believed these will be the major driving force of social change in the immediate future and that we are at the dawn of a new social revolution which many believe will have similar significance to that of the Industrial Revolution. Future society is being described as an Information Society.

Acknowledging the importance of these developments, the NZ Commission for the Future set up a policy research group in October 1980 to identify the major trends in the development of communication and information and to consider their impact on New Zealand. This paper describes the work carried out by this policy research group.

3.0 THE NZ COMMISSION FOR THE FUTURE

The NZ Commission for the Future, established in 1977, is not a policy making body as such. Its functions are set out in the NZ Planning Act 1977 which states that the general functions of the Commission shall be:

- (a) To study the possibilities for the long-term economic and social development of New Zealand.
- (b) To make information on these possibilities available to all members of Parliament and to publish such information for wide dissemination.

- (c) To promote discussion on these possibilities and information relating to them.
- (d) To report to the Minister on these possibilities.

In carrying out its general functions the Commission shall:

- (a) Give special attention to the long-term implications for New Zealand of new or prospective developments in science and technology; and
- (b) Have regard to prospective trends, policies, and events in New Zealand and overseas which could have important consequences for the country's future. (1)

Thus, the Commission attempts to affect policy by an indirect process of informing and educating politicians, policy-makers and the public, on long-term developments.

The first major work of the Commission in 1978 was to identify the likely shape of the future world and New Zealand's place in it. This study was designed to bring home to New Zealanders the choices which are available to them, in the belief that each limitation can be viewed constructively and used as a way to define opportunities and focus energies rather than as a constraint upon choices. (2)

Following this first work the Commission developed a set of four alternative contexts within which New Zealand could develop. Believing that the best future for the country will result from the expressed desires of well informed New Zealanders the Commission for the Future presented the contexts as an analytical tool.

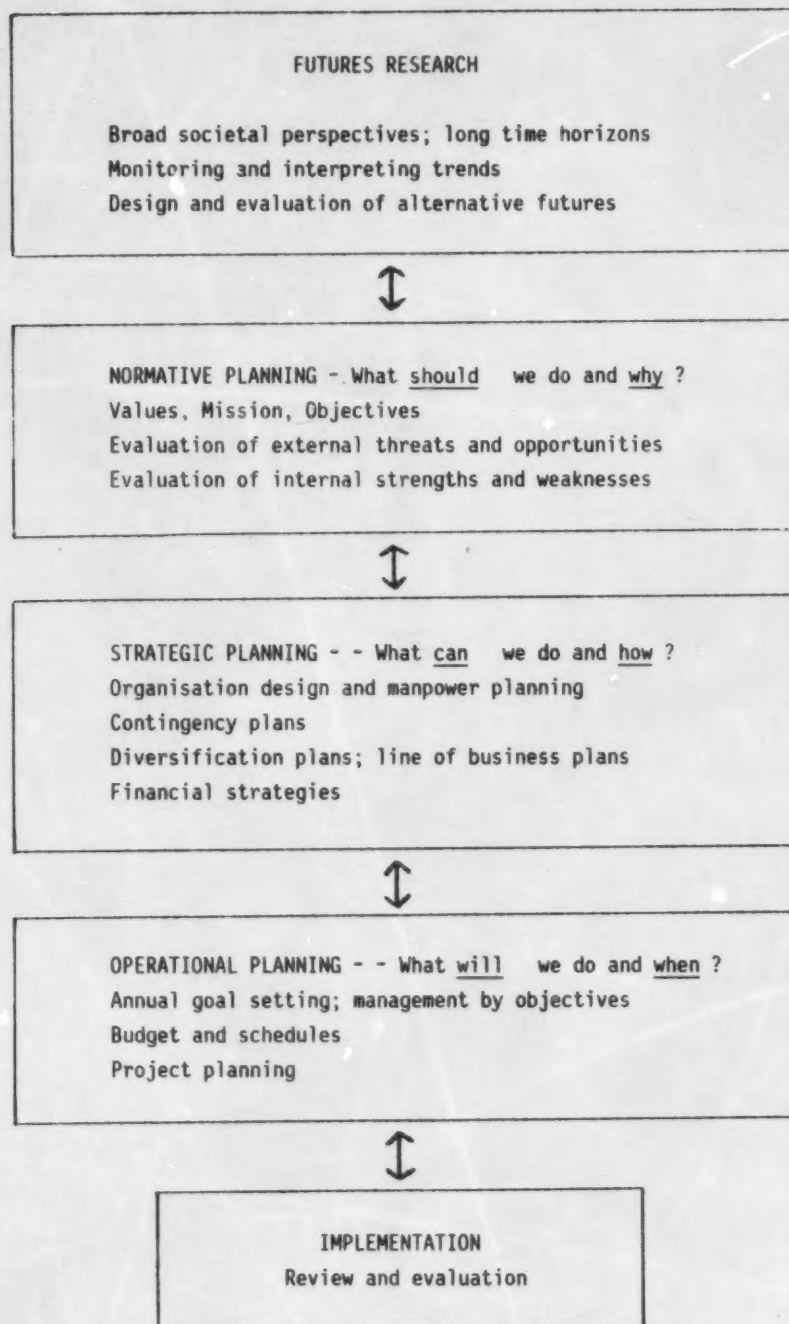


Figure 1 A GENERAL PLANNING MODEL

The contexts can be used to help people clarify their opinions, values and aspirations and to match them with resources and forecasts in order to allow consistent sets of decisions to emerge. (3)

In the course of these initial major studies a number of key issues were identified which required specific detailed analysis. These issues were:

- (i) Communication and information
- (ii) Contingencies for disaster
- (iii) Work

The Commission established separate policy research groups to carry out detailed analysis of each of these areas.

The communications policy research group which the author co-ordinated was the first to be formed and has pioneered this new area of activity for the Commission.

4.0 FUTURES RESEARCH

It is useful to consider the place of futures research within the overall planning process. This is shown in Figure 1. Futures research has long time horizons and in the case of the NZ Commission for the Future this is nominally 30 years. It aims to develop broad societal perspectives, monitor and interpret trends and to design and evaluate alternatives for the longer term future.

Futures research can provide insights and foundations for normative and strategic planning which should proceed operational planning and implementation. Long term perspectives developed through futures research provide an important basis for anticipatory policy making during latter planning stages. Such perspectives can help society exploit the best advantages of new technologies and major environmental changes and ease the impact of major disadvantages.

5.0 POLICY RESEARCH

The objectives of the communications policy research group were broadly set out as:

- (i) to identify key issues for discussion
- (ii) to indicate and consider major trends
- (iii) to present these in a form suitable for the information and education of the public and for use by policy-makers.

The group did not indulge in detailed planning and forecasting particularly in the areas of costing and timing of possible developments.

6.0 "NETWORK NEW ZEALAND" REPORTS

The multidisciplinary group of five worked part time for nearly twelve months and published its report "Network New Zealand: Communications in the Future" in September 1981. This summary report aimed at conveying to the general public the complex technical developments in communication and information and their possible social impacts. The report is based on a set of separately published working papers written by individual members of the group and additional input papers commissioned from several outside contributors. The papers include:

1. "Towards a Communication and Information Policy for New Zealand".
A discussion paper by Myra Harpham.
2. "Information Occupations: The new Dominant in the New Zealand Work Force". An analysis by Michael Conway.
3. "Communication Needs and Rights; Communications in four New Zealand Contexts".
A working paper by P.W. Harpham, Marie Keir, Gerald E. Moriarty and George Van Valkenburg.
4. "Communications to the Year 2010: Some Social, Political and Economic Issues." Marie Keir.
5. "Computer Communications and Information Services." Notes by P.W. Harpham.
6. "The Future of Broadcasting and Frequency Spectrum Usage in New Zealand." A Working paper by Gerald E. Moriarty.
7. "The New Zealand Daily Newspaper: An Endangered Species." A working paper by Michael Conway.
8. "Point-to-Point Communication in New Zealand over the next 20 Years." A working paper by John P Moriarty.
9. "Space Satellite Distribution". An input paper by George Van Valkenburg.

7.0 COMMUNICATION AND INFORMATION

In beginning to look at the many changes expected to take place in communication and information it is important to reflect on the fundamental nature of the subject area.

Communication is that essential process by which humans act socially. It is the process by which people co-operate and survive in societies - the process by which they do business and partake in recreation. Communication in its most basic sense can be defined as all the procedures by which one mind affects another. Information is the substance of communication.

The work of the policy research group has identified significant trends in these two essential components of our lives that have the potential to produce major changes in the way people relate to each other and the way they conduct their daily lives in the future.

8.0 APPROACH TO TASK

The group approached its task by considering the following concepts: communication needs, social values, communication goals, technological trends, and policy alternatives.

8.1 Communication Needs

In looking at the impact of long term trends in the development of any subject area it is necessary to have a definition of the anticipated social environment over the research period and for this purpose the group was able to use the four alternative social contexts developed by the Commission in its earlier work. The group began by considering the concepts of communication needs and rights and attempted to analyse these in terms of the four development contexts. This is the subject of one of the detailed working papers.

8.2 Values

The analysis of communication needs highlighted the essential nature of the communication and information and the complex relationship between communication needs and overall national development - the two are inextricably tied together and cannot be considered separately. Communication needs are a function of overall social values and hence social development.

In order to keep the task of the policy research group manageable the group concentrated on the important social values identified by two social attitude surveys undertaken by the Commission for the Future. The first in October 1980 (4) was reinforced by a Televote survey in 1981 (5).

The surveys indicated that New Zealanders placed about equal emphasis on growth in both economic and social - environmental living standards embracing the following aspects in order of importance:

- indefinitely sustainable use of natural resources;
- redeployment of unemployed economic production workers in social production activities;
- economic growth from more import substitution orientation, less export orientation;
- mixed scale industries;
- a wide variety of work and creative use of increased leisure time; within the scope of a wide variety of life styles;
- a more co-operative and less competitive society;
- a mixture of advanced and simple technology in use, with specialised production of computer technology goods and services;
- economic and social equality throughout society;
- less central government, more regional and community government;
- stronger links with Pacific Nations than other countries.

These values provide the basis for projection by the policy research group of communication developments likely to be implemented in New Zealand in the future and the possible impacts they might have.

8.3 Goals

Because of the extent of change anticipated in communication and its importance to future social development it is expected that an explicit national communication policy will become necessary. Such a policy should set national communication goals which although not always fully attainable should provide guidelines for decision-makers and act as focal points and bench marks for the measurement of day-to-day progress.

The "Network New Zealand" report includes several goals which the group regarded as important to such a national communication policy:

"Communications/information systems should be recognised as essential national resources and services fundamental to the healthy development of New Zealand society.

They should supply the communication necessary for individual self-fulfilment in a caring community by providing:

Future communication/information services designed to strengthen democracy.

Equitable distribution of communication services.

Equitable access to all such services, domestically and globally.

Equitable access to employment opportunities and education; recreational entertainment and information services; and sources which enhance a sense of community.

Indigenous content and the opportunity to communicate in any preferred language.

Protection of individual and group rights of privacy, thus enhancing the dignity, freedom and independence of all New Zealand residents". (6).

Such goals should be subject to widespread public debate along with others which need also to be considered.

8.4 Technologies

The policy research group identified what it believed to be the major technological trends in communications relevant to New Zealand over the next 20 to 30 years. Most of the developments are in fact applications of currently known technology. It is entirely probable that there will be a number of completely new and as yet unpredicted innovations in communications technology during this time. Such innovations could have a further significant effect on our lives.

The group did not consider developments such as:

- communication with extra-terrestrial beings;
- communication with animals, for example, dolphins;
- widespread use of telepathic communication;
- direct sensory interconnection between man and machine.

Many futurists predict these as being amongst the next wave of communication development and possibly within the time frame of the study.

8.5 Policy Alternatives

Finally the group considered a number of policy alternatives which fit the described technologies to the suggested goals and values. This shows the vital link between values, goals, technologies and policy.

Policy must mediate the use and application of technology to achieve defined goals which should be based on widely held social values.

9.0 "NETWORK NEW ZEALAND"

The idea of "Network New Zealand" the title of the group's report is based equally on the sociological concept of social communication networks as on the technological idea of physical networks. New Zealand is already a network nation of sorts. It has strong social networks that support families, individuals and business. It already has good telephone, telegraph, broadcast and transport networks.

The country is already well laced with copper cables, and microwave systems for telephone and data services and a limited number of radio and television channels cover most of the land area. However, in the future it is expected that the narrow band networks of today will be replaced by wide bandwidth channels which will be capable of carrying higher volumes of information, many new types of services, and transmissions with increasing quality of reproduction. Present copper cables are likely to be replaced by cables which carry information in the form of light - i.e. optical fibre cable. Satellites will extend wideband channels into remote areas and complement cables within urban areas. Wideband networks are expected to carry multimedia communication services providing a wide variety of different forms of communication on the one physical cable or through the one satellite.

10.0 ELECTRONIC HIGHWAYS

There are many useful analogies between the current transport systems and expected future communication systems. The policy research group believes the New Zealand roading system offers a good model for the development of future wide bandwidth communication channels or electronic highways. Such highways should be available to every home and business in the future and like the roadway be freely accessible to private and public users with whatever type of terminal (within good reason) they wish to connect once a basic technical criteria similar to a vehicles' warrant of fitness or safety certificate has been obtained. Networks should be lightly regulated, well functioning public services like the current roading system.

11.0 TECHNOLOGICAL DEVELOPMENT

In summary the policy group expects the technological trends of the future will produce:

- many new types of information exchange e.g. viewdata type services of very high quality;
- channel abundance;
- multi-media networks;
- proliferation of global services: e.g. information and entertainment services;
- continuing decreases in the size and cost of computing equipment;
- many more participatory two-way forms of communication;
- much higher quality of reproduction e.g., high quality data transmission of documents and new standards for television transmission. In the future a high resolution, large screen, three-dimensional television standard will be possible and new forms of electronic video will change the role of existing theatres and cinemas.

Many of the technologies and services already exist but in primitive form. In the next 30 years these can be expected to develop into high quality efficient operating systems.

12.0 INFORMATION SOCIETY

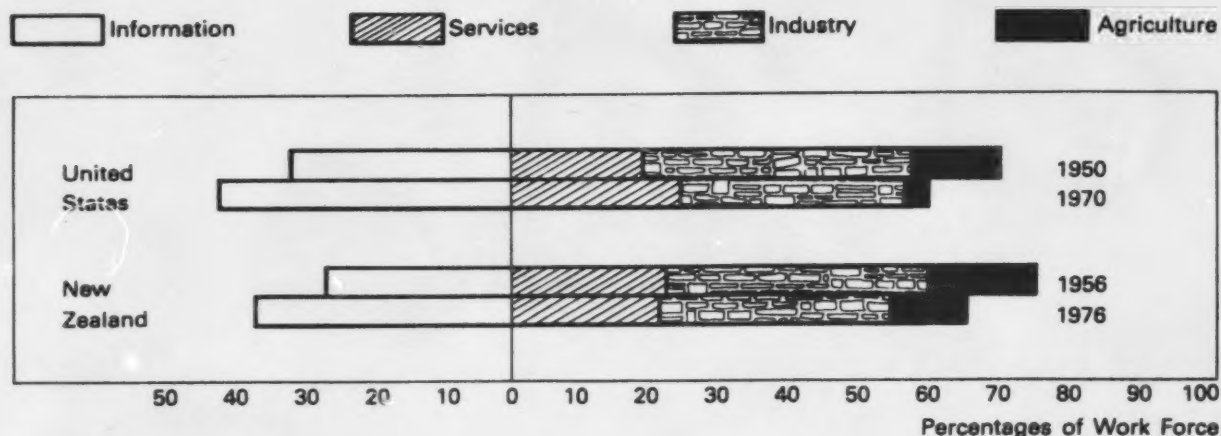
The social revolution resulting from the widespread availability of new information technologies is expected to produce an Information Society in the future. That is one in which:

- highly efficient telecommunication highways and computers will provide the means of revolutionising the handling of information just as the road and transport systems changed the handling of raw materials at the beginning of the Industrial Revolution;
- information will become a much more important tradeable commodity;
- it will be a key economic resource similar to labour and capital and could eventually require new economic models and rules;
- the major economic production is expected to be in the now well defined information sector of the economy;
- employment in the information sector will be largely changed as a result of new information technologies.

Figure 2 shows the development of the information workforce in New Zealand compared with that in the United States.

DEVELOPMENT OF INFORMATION SOCIETY

Four-Sector Separations of Work Forces



Sources: United States figures from OECD paper DSTI/ICCP/80.10. New Zealand figures from Network New Zealand working paper on information occupations

Figure 2

13.0 EMPLOYMENT

Many of the theories of the Information Society are being developed in the United States and Europe. On the one hand in the United States there appears an optimism that information industries will proliferate and provide growing employment. The European view is more cautious and predicts widespread unemployment, at least in the mid-term as the information sector becomes largely automated and the impact of information technologies is felt.

One of the discussion papers commissioned by the policy research group analyses the extent of information occupations in New Zealand. The information sector of the workforce is now well defined; for example by the OECD. It is a wide sector of the economy and workforce including essentially all workers who handle information and symbols as against commodities or goods. It therefore includes teachers, accountants, managers, solicitors, clerks, politicians, etc. as well as the obvious communications and computer industry workers.

14.0 CONVERGENCE

The single most significant impact of communication development identified by the policy research group is one of convergence. This is seen in the following:

- all media are becoming electronic, for example electronic publishing, electronic newspapers and new forms of cinema through electronic video;
- at a technical level all electronic media are moving to digital transmission;
- there is a general move towards concentration of ownership of communication and information services;
- organisational structures are becoming horizontal with the development of information providers, for example writers, editors, archivists, etc., who may serve publishing, radio, television, cinema and new data services interchangeably. Separately, technical facilitators are emerging who will provide the technical systems for a range of different communication media.

The latter two instances of this convergence phenomenon are currently evident in New Zealand as the newspaper groups compete to enter the electronic media.

15.0 POLICY ALTERNATIVES AND CAUTIONS

There are many complex social issues resulting from the introduction of new information technologies. These will require very careful consideration by policy-makers and should involve extensive public debate. It was the purpose of the policy research group's work to generate public awareness and initiate discussion on these important issues. The following are just a few of the key issues raised by the group.

The funding and tariff policy for communications services can either increase or decrease the information gap between rich and poor. Strict user-pays systems may reinforce the power of large companies, the affluent and the educated. However, widely available baseline services can spread the benefits of the information society to any remote location, to minority groups, to the handicapped and the less affluent. The policy research group have suggested a new funding policy based on a single overall communication service fee for which a range of basic services is supplied and beyond which a whole variety of additional services could be available on a user-pays basis.

Computer and information networks have the power to "never forget". An authoritarian society could assemble personal dossiers on each individual. The information might or might not be completely true. New Zealanders need to decide whether there are limits placed on the information compiling powers of financial and governmental agencies, and whether mechanisms are provided whereby individuals should be able to review their own files for accuracy and completeness.

With the increasing number of communication channels in the future there will be a high demand for services and systems that efficiently handle information and improve the effectiveness of communication so that information overload does not become an even greater problem than it is for some already.

Literacy, graceful language and creative manual arts are at risk while electronic displays remain limited in the number of words they can display on screen and by the fidelity of their pictorial material.

The flow of information across national borders is already an issue of considerable international concern. This will grow as the extent of trans-border communication proliferates. That which is legal in one country may be illegal in another - subversion and computer crime can flourish worldwide, and be difficult to detect.

There will be a tendency towards harmonisation of culture and languages. It is evident today through American television programming. The potential will be increased as more media become global. On the other hand new information technologies offer the potential to provide individualised communication instead of mass media communication and decentralization of input and control. Without the unifying effect of the mass media this could eventually lead towards social fragmentation with everyone doing their own thing.

It seems most appropriate that a predominant single public Transmission Authority will evolve within New Zealand with control of the major multi-functional communications network. However, the policy research group believes opportunities should exist to allow private enterprise to establish parts of the overall network.

The group believes there should be maximum relaxation of regulation on the use of the network and connection of terminal facilities as long as these meet basic technical requirements. Both private and public bodies should develop as information producers and presenters.

Any modification to traditional employment patterns should be approached in co-operation with employees and unions. The tools of communication can be used for increasing public understanding of employment problems and solutions, as well as opportunities for retraining and relocation of workers.

Foreign majority ownership of key elements such as space satellites or foreign acquisition of communications companies or information providers may be undesirable. Existing laws may need to be modified to cope with the changing technology.

16.0 RECOMMENDATIONS

It is impossible to forecast many of the social consequences of the application of new information technologies. There will be many technical and engineering problems that will need field trials to solve. Accordingly the policy research group proposed the establishment of a number of demonstration communities or evaluation projects where both technical and social issues could be studied. There are obvious costs in such a proposal but the group believes these are well justified in view of the extent of change that such trial services will eventually produce if widely introduced.

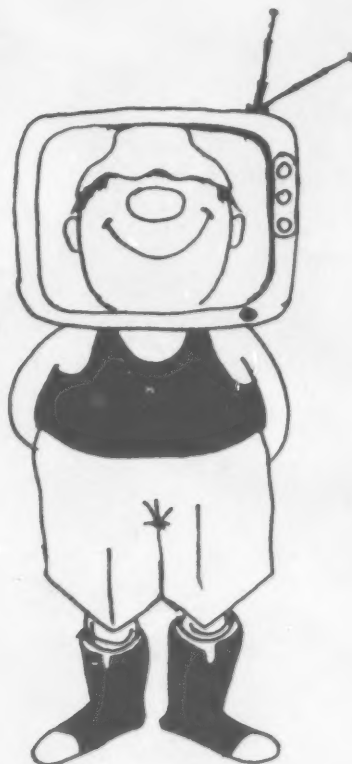
It is suggested these evaluation communities or projects could begin very modestly and evolve as new technologies become available. They might begin by setting up small multi-functional cable systems for the combination of broadcast, telephone and data reticulation or the establishment of community communication centres.

Already a number of elaborate demonstration projects exist in Canada, Japan and France for example. It is hoped that through similar but probably smaller scale evaluation projects New Zealand can develop both technical and social innovation in the use of information technologies involving local New Zealand enterprise just as the country has proved so competent to do in the past.

Finally the group was so struck by the extent of change likely in the development of communication and information the members firmly believe that if communication policies are to help shape New Zealand's future, then public debate on the issues and possibilities must continue. The group saw an urgent need for improved or strengthened mechanisms to achieve this and to take a firm lead in anticipatory communication policy research and broad national integrated planning. The group have suggested the establishment of a permanent Statutory Authority to fill this critically important requirement.

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Land Mobile Telephone Service in Japan

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Abstract

To cope with increasing demands, the Nippon Telegraph & Telephone Public Corporation implemented a high capacity land mobile telephone service in 1979. This service, employing a cellular system in the 800 MHz band, has been found to be highly satisfactory by users. This paper provides an outline of the present status and the future plans for this service as follows:

1. INTRODUCTION

The land mobile telephone service in Japan was first introduced in the Tokyo metropolitan area in December 1979.

Public telecommunications services in Japan are provided by the Nippon Telegraph & Telephone Public Corporation (hereinafter called "NTT"), which has already completed its long-standing goal of automating all telephones throughout the country, together with the elimination of its backlog of applications for new telephone installations.

NTT has now about 39 millions telephone subscriber lines in service, which are the services for fixed locations. Services for mobile locations are expected to be on the road to expansion through the introduction of the land mobile telephone service. This service is being provided by NTT to cope with the increasingly strong demands from social and economic fields that telecommunications be possible at any time, any place and to any destination.

The following are a description of the present status and the future plans of the land mobile telephone service.

2. PRESENT STATUS

2.1 SERVICE INTRODUCTION

The land mobile telephone service reached about 10 thousands subscribers in September 1981, with a series of service introductions in the Tokyo and Osaka service blocs. The present service status is shown in Table 1.

Table 1: THE LAND MOBILE
TELEPHONE IN SERVICE

(As of Sep. 1981)

Area	Number of sub-scribers	Service introduction date
1. Tokyo service bloc		
• Tokyo 23 wards	5,062	December 1979
• Tokyo peripheral area (Yokohama, Chiba, Urawa, Tachikawa)	1,907	March 1981
Sub Total	6,969	
2. Osaka service bloc		
• Osaka	2,387	November 1980
• Osaka peripheral area (Kobe	444	
(Kyoto, Nara	216)	July 1981
	228)	September 1981
Sub Total	2,831	
3. Total	9,800	

2.2 SERVICE UTILIZATION

2.2.1 USERS STATUS BY KINDS OF INDUSTRY

Approximately 81% of mobile telephone users come from private companies followed by individuals, hospitals and government agencies. The construction industry leads among private companies, as shown in Table 2 and 3.

Table 2: USERS STATUS BY KINDS OF INDUSTRY

	Private companies	Individuals	Public Corp. Hospitals	Government agencies	Total
Number of subscribers	7,973	1,200	437	190	9,800
%	81.3	12.2	4.3	2.2	100.0

Table 3: MAJOR PRIVATE COMPANIES

	Construction	Machine	Finance and real estate	Service	Transportation	Others	Total
Number of subscribers	1,462	1,215	1,020	685	445	3,146	7,973
%	18.3	15.2	12.8	8.6	5.7	39.4	100.0

2.2.2 USERS STATUS BY KINDS OF VEHICLES

Statistics show passenger cars command an absolute majority while trucks account for few mobile units. This probably means that business executives utilize this service for administrative purposes. However, it is worthy of our notice that the utilization trend has changed from use by business executives to general business use, as the number of mobile units for salesmen and transportation vehicles, high-way omnibus and private taxi cabs have been increasing, as shown in Table 4.

Table 4: USERS STATUS BY KINDS OF VEHICLE

	Passenger cars	Trucks	Special cars	Omnibus	Total
Number of subscribers	9,192	457	104	47	9,800
%	93.8	4.7	1.1	0.4	100.0

2.2.3 TRAFFIC

The calling rate is about 4 calls per subscriber per day on average. Mobile-originating calls are about 4 times ordinary telephone-originating calls. The average call duration is approximately 110 seconds, which is somewhat shorter than ordinary telephone-originating calls.

The call charge steps are classified into 3 steps (up to 160 Km, up to 320 Km and over 320 Km), and calls up to 160 Km amount to about 90 per cent of all calls.

2.3 OUTLINE OF SYSTEM

2.3.1 MAJOR CHARACTERISTICS

The land mobile telephone system was developed to meet the expanding demands to achieve a) high subscriber capacity, b) efficient radio frequency spectrum utilization and c) nationwide service.

Some major characteristics of this system are described as follows:

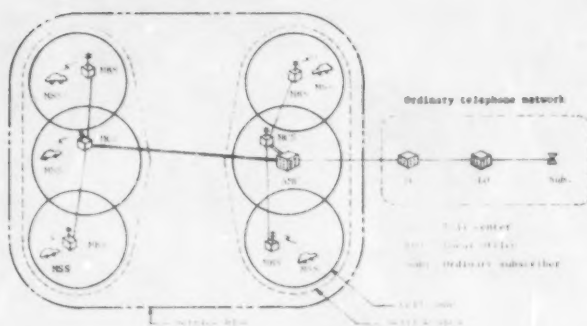
- (1) The 800 MHz frequency band is used where a wide bandwidth necessary for a high capacity system is obtainable.
- (2) Efficient radio frequency spectrum utilization and speech quality equalization are carried out by employing the so-called "Cellular system" (small radio zone method with a radius of 5 to 10 Kilometers), which means that the coverage area for one mobile base station (called "cell area") is small, and the same frequency channels are re-used within a comparatively short distance.
- (3) In order to serve the maximum number of mobile users in each cell area, 600 radio channels can be provided. Each mobile unit is capable of automatically selecting any one of the available channels.
- (4) Each mobile unit transmits a location registration signal to the Automobile Switching Center (AMC), where location data is stored in the memory of electronic switching system for paging purposes (Location registration). Selective calling by each mobile unit is carried out only in the paging area where the unit is registered (paging).
- (5) When a mobile unit moves from one cell area to another during a conversation, the speech channel is automatically switched without disrupting the call (Hands off).
- (6) Automatic exchanges between mobile units and ordinary telephones have been established on a nation-wide basis.
- (7) An electronic switching system is used in AMC, and performs the following functions by stored program control:

- Connection between land mobile telephones and ordinary telephones.
- Charging to mobile users.
- Location registration.
- Paging in the registered location.

2.3.2 OUTLINE OF SYSTEM

- (1) The land mobile telephone system is composed of the Automobile Switching Center (AMC), Mobile Control Station (MCS), Mobile Base Station (MBS), Mobile Subscriber Station (MSS, mobile unit) and transmission lines between them, as shown in Figure 1.

Fig. 1: LAND MOBILE TELEPHONE SYSTEM CONFIGURATION



- (2) The major functions of these stations are as follows:

- Automobile Switching Center (AMC)

The AMC includes an electronic switching system modified for land mobile telephone service.

- Mobile Control Station (MCS)

The MCS handles radio path set-up, hands-off and location registration controls and supervises mobile base station radio equipment and radio circuits.

- Mobile Base Station (MBS)

The MBS Transmits and receives radio signals and measures radio circuit quality for each call.

- Mobile Subscriber Station (MSS, mobile unit)

The MSS transmits and receives radio signals, tunes the radio channel and transmits its location indicating signal to the AMC

via the MBS and the MCS.

2.4 OUTLINE OF SERVICE

2.4.1 MOBILE UNIT

The mobile unit consists of a mobile radio unit (transceiver), telephone set and an antenna.

The small, light-weight mini-pushbutton telephone set has been designed for convenient use in the limited space of a vehicle. The telephone set has such necessary functions as a sound volume control switch, an electric power switch and two illuminating indicators showing "out of service" and "power on". The telephone set can be installed in one of three places: the armrest, the rear of the front seat, or the rear window tray.

A call-hold button is installed near the driver's seat for safety. When a call comes in while the vehicle is moving, the driver can hold the call by pushing this button. Then, a taped announcement informs the caller to wait for response for a while. With this function, a driver can safely respond to a call after stopping the car.

2.4.2 CALL SERVICE

- (1) Most services provided by the public telephone network also are available to mobile users. Emergency police and fire services, for example, can be obtained by dialing the universal codes 110 and 119, respectively. Mobile users also can send domestic telegrams by dialing 100. Overseas telephone and telegraph services, however, are not available.

- (2) Calls originating from and terminating in a vehicle can be placed throughout the country only when the vehicle moves within the service bloc to which the land mobile telephone belongs. (Japan will be divided into about 10 service blocs which are almost equivalent to the Bureau's administration blocs.)

- (3) • For a mobile-to-ordinary telephone call, the user would dial:

0 + area code + local telephone number (for example, to Tokyo 23 wards, 03 + XXX + XXXX)

• For an ordinary telephone-to-mobile or mobile-to-mobile call, an ordinary telephone subscriber or mobile user would dial:

0 + 30 (mobile phone service code) + YY (mobile phone area code) + XXXXX (mobile phone number)

• The mobile phone area code for the Tokyo 23 Wards is 31, and a similar code is assigned to each prefectural area.

• When the electric power of the mobile unit is turned off or the vehicle is moving

outside the service bloc, the originating subscriber will be informed to that effect by a taped announcement.

2.4.3 OPTIONAL SERVICES

Optional services include one blanching extension set for each mobile telephone.

The mobile radio unit is designed for 12 volt DC operation. With the power converter, the set can also be used in vehicles with a 24 volt battery.

In order to guard against unauthorized use of the mobile telephone, a-dial-lock-button can be added to the telephone set.

2.4.4 RATES

(1) The land mobile telephone service has been approved as an experimental public telecommunications service for five years following service introduction, because it is a new service and it is not possible to fully foresee the trend of demand, customers' needs and future technical developments.

(2) The main points concerning rates are as follows.

- Subscription fee and installation charge, one-time charges at initial installation, are the same amounts as those applied to conventional telephone service.
- Call charges are based on call duration. The main difference between this service and conventional service is that there are three call charge steps for this service while there are fourteen steps for conventional calls.

(3) Main tariff

- Subscription fee ¥300
- Installation charge ¥80,000
- Basic monthly charge ¥30,000
- Call charges As shown in Table 5.

Table 5: CALL CHARGES

	Dial-call charges (10 Yen for each block of seconds as shown)		
	Daytime 8:00 ~ 19:00	Night 6:00 ~ 8:00 19:00 ~ 21:00	Midnight 21:00 ~ 6:00
Up to 160 Km	6.5 sec.	12 sec.	
Up to 320 Km	4	7	8.5
Over 320 Km	3	5	7.5

Remarks: These call charges are also applied to ordinary telephone-to-mobile calls.

2.4.5 BUSINESS CONSIGNMENT

Work such as sales, installation, maintenance, repair, billing and collection have been consigned to newly established companies.

They are Tokyo-based and Osaka-based companies half of the financing of which comes from NTT.

3. PLANNED FUTURE SERVICES

3.1 USERS DEMAND

A survey of users' reactions to the land mobile telephone service showed that almost all the users thought the service was very convenient. It also showed that they hoped for extensive service area expansion and for the miniaturization of the land mobile unit, especially the radio transmitting set.

According to instructions from the Police Agency regarding traffic safety, a vehicle driver is advised not to use this service in moving.

However, users have indicated a strong desire to be able to use the service in any situation.

3.2 SERVICE AREA EXPANSION

(1) It is planned for the service area to be expanded first in the center cities of each service bloc, such as Nagoya, Hiroshima, Fukuoka, Sendai, and Sapporo, followed by prefectural capital cities and other cities along principal highways. To realize this goal, an economical land mobile telephone system for small and medium cities has been developed.

- (2) The present service is called the bloc service, because the service is usable only when the vehicle moves in the service bloc to which the land mobile telephone belongs. To realize nation-wide service, a subscriber's information transmission system (remote file access) will be necessary between Automobile Switching Centers. The CCIS (Common Channel Inter-Office Signalling System) will be introduced to accomplish remote file access.
- (3) The national wide-area service where the land mobile telephone can be connected even outside the service bloc will be introduced in the near future, and finally, a national non-mobile-phone-area-code service will be implemented.

3.3 MINIATURIZATION OF MOBILE RADIO UNIT

A miniaturized and economical mobile radio unit has been developed and is planned to be used in 1982. The major specifications are as shown in Table 6.

Table 6: MAJOR SPECIFICATIONS FOR MOBILE RADIO UNIT

	Present unit	Redesigned unit
Size	90 x 230 x 320 mm	50 x 140 x 214 mm
Volume	6.6 ℓ	1.5 ℓ
Weight	7 Kg	2.4 Kg

3.4 OPTIONAL SERVICES

The commercialization of the following services has been studied:

- (1) Auto-antenna (automatically stretched antenna)
- (2) One-touch-dialing (Frequently called telephone numbers will be registered in advance)
- (3) Hand-free-phone (Calls can be made without using hands)
- (4) Public pay land mobile telephone for use of passengers in commercial transportation vehicles.
- (5) Facsimile and data communication

4. CONCLUSION

In recent years, the number of vehicles in Japan has increased remarkably, and presently totals

about 35 million. It goes without saying that vehicles have played an important role in Japan's economic and cultural expansion, and have also become indispensable to daily home life.

Under these circumstances, the land mobile telephone service has just started. The demands for this service are expected to increase remarkably according to the wide penetration of this service into the economic-social life and as a result of service area expansion.

The present land mobile telephone service is provided simply as "a movable telephone" with the minimum necessary functions. NTT, taking into consideration customers' needs and social-economic trends, will make efforts to provide more useful and improved land mobile telephone services. Through these advances, vehicles will be able to serve as moving offices, and as communication media in our information-oriented society.

THE UNITED STATES ROLE IN PACIFIC TRANSBORDER FACILITY PLANNING

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The United States, through the Federal Communications Commission ("FCC or Commission"), has commenced an inquiry designed to forge a comprehensive plan which would guide the construction of transborder telecommunications facilities in the Pacific basin over the rest of the century. Telecommunications interests abroad should view this initiative with both pleasure and pain: It is the first official recognition of the importance of the region to United States telecommunications policymakers. However, policy decisions made by the United States will impact directly and may constrict significantly decision-making by foreign entities. In addition, these policy decisions may reflect broader considerations of telecommunication and trade policy.

1. BACKGROUND

International telecommunications is, by its nature, a cooperative undertaking among sovereign nations. Planning decisions in the field are primarily a product of negotiations. Each facility and service offering requires agreement of two or more entities. These entities are subject to the differing laws and interests of their own sovereign nations and to their own economic and other self interests.

Negotiations for submarine cable facilities are essentially bilateral between the United States' primary carriers, American Telephone and Telegraph Company and the international record carriers on the one hand, and the entities which operate the foreign end of the cable on the other. These negotiations do not contemplate any global perspective; they are instead limited to commitments between two sides concerning one major international path.

Negotiations and planning for satellite facilities takes place in the International Telecommunications Satellite Consortium ("INTELSAT"), a forum entirely separate and apart from the cable negotiation process. The planning process in INTELSAT is not conducted in the forum of bilateral negotiations but is the outgrowth of deliberations among the numerous nations participating in the organization.

Representation of United States' interests in these negotiations is extensively fragmented and, from the United States' viewpoint, not conducive to cost minimization. In accordance with the Communications Satellite Act of 1962 and the arrangements establishing the international consortium, Comsat is the designated United States entity to INTELSAT. While Comsat is the sole United States participant in INTELSAT planning for satellite development, the data on which such planning is based are provided by the United States primary carriers and their foreign correspondents. Planning decisions within INTELSAT

are made by weighted vote in relation to ownership of the system. Ownership, in turn, is related to relative use of the system. Comsat's ownership comprises currently approximately 25% of the system.

From the perspective of the FCC, the goals of the primary carriers and Comsat are often at odds with each other and with consumer interests and public policy. Under the rate base/rate of return regulation applied traditionally by the FCC, carriers do not have the incentive to minimize investment, unlike firms operating solely under the constraints of a competitive marketplace. According to the FCC, this principle applies to the AT&T, the dominant service carrier, and may apply to the international record carriers as well. ^{1/} In the case of the primary carriers, they are said to have both the economic and operational incentives to minimize the use of leased satellite capacity in favor of owned cable capacity. Similarly, Comsat is said to have the same economic incentives within its narrow technological focus. Because the primary carriers are both users and owners of telecommunications facilities and because Comsat is entirely dependent on the primary carriers to lease its satellite circuits, there is no competition between alternative sources of supply which would encourage cost minimization.

Thus, in the exercise of its statutory mandate under Section 214 of the Communications Act of 1934, the Commission reviews closely major international facility proposals in which United States carriers participate. Traditionally, these facility proposals were reviewed on an ad hoc basis. For instance, in the case of TRANS-PAC II, currently the major Pacific basin cable facility, the Commission was presented with an application to construct the facility in 1971. The Commission had no formal contacts with United States carriers or foreign administrations concerning the need for the proposed project prior to the filing of the application, nor in

reviewing the application did the Commission consider alternative proposals for meeting traffic demand in the long term. 2/

Foreign operating entities working closely with the related government departments had previously determined their facility requirements. United States carriers determined their requirements without consultation with their regulators. Nevertheless, contracts were signed in contemplation of FCC approval. In its decision, the FCC questioned whether the TRANSPAC II facility could be justified solely on the basis of the relatively small traffic growth rates then experienced. However, it authorized the facility primarily on the basis of national security considerations. 3/

2. Modification of Foreign Commitments

The FCC did not withhold approval of TRANSPAC II despite some feeling at the Commission that it would have been justified in doing so. In more recent years the Commission has been less reluctant to require changes in the facilities proposed or how they were used if its analysis indicates that there are more efficient alternatives than those proposed by the carriers.

For example, in the Caribbean basin, the FCC rejected a proposal for a cable system which would interconnect the mainland United States, Puerto Rico and the Virgin Islands, Brazil and Venezuela. The United States carriers, EMBRATEL and CANTV had undertaken negotiations for three years prior to reaching agreement. After the application was filed, the Commission engaged in protracted and extensive correspondence with the applicants in an attempt to obtain additional information relating to traffic forecasts, costs and alternative facility configurations. In acting on the application, the Commission approved the portions of the cable system which would reach Brazil and Venezuela. However, it denied a license for a crucial portion of the project on the mainland United States -- Puerto Rico/Virgin Islands route and asked the applicants to explore a number of specific alternatives. 4/

The application was refiled by the carriers, this time with the proposal to include only a portion of the investment in the mainland/Puerto Rico-Virgin Islands links in their rate bases for ratemaking purposes. This proposal was also rejected by the Commission. 5/ More than seven years after commencing negotiations for the project, the parties had yet to obtain regulatory clearance. Finally, one year later the FCC authorized the installation of circuit multiplication equipment on an existing cable to accommodate extension of circuits on the Brazil and Venezuela cables. 6/

The United States carriers are understandably resistant to these kinds of FCC actions and they are increasingly vocal in their belief that they are an unwarranted interference in decisions best left to carrier management. In the FCC's view,

its statutory authority is premised on a Congressional recognition that private business decisions are not necessarily consistent with the interests of the public. Whatever the proper exercise of authority over domestic corporations, it is apparent that the Commission has no authority *de jure* over foreign administrations. It is not difficult to understand why foreign administrations may be offended by what they perceive as the FCC's ability to unilaterally modify their commitments.

3. Development of Comprehensive Planning

In an attempt to carry out its public interest mandate and preserve cordial relationships with foreign administrations, the FCC has evolved the concept of comprehensive planning. Thus, the Commission has been engaged in a proceeding designed to develop a long-range facility plan for the North Atlantic basin. The proceeding is intended to allow the Commission to consider satellite, cable and lightwave fiber-optic alternatives in an integrated fashion. The goal is to develop an overall plan for the establishment and use of facilities in the region through year-end 1995. 7/ The assumption is that if the Commission, in concert with foreign administrations, develops a comprehensive plan, it could expeditiously process facility applications consistent with it. 8/

The attempt to institute comprehensive facility planning in the North Atlantic region has been a complex and costly undertaking. The process had its beginnings in the early 1970's when the FCC refused to consider proposals for an additional transatlantic cable facility. 9/ European administrations reacted sharply. A series of meetings between representatives of the FCC, the United States carriers and the European administrations were held and papers were exchanged. In the most significant of these papers -- the so-called "Spoleto Document" -- the European administrations criticized FCC efforts to restrict the flexibility of foreign operating entities in their use of transborder facilities. However, the document also suggested that administrations should exchange on a regular basis information concerning their facility plans and policies. 10/ A meeting addressing concerns raised in the Spoleto Document was held in Munich in October 1974. It was at the Munich meeting that the FCC offered its framework for comprehensive planning -- a consultative process to consider basic factors affecting facilities planning. European administrations agreed to give consideration to this approach. 11/

Shortly thereafter, the Commission issued a statement of guidelines concerning utilization of North Atlantic facilities. According to the FCC, the objective of the guidelines was

the achievement and efficient utilization of the lowest cost combination of facilities which

can satisfy valid traffic needs and service standards, irrespective of technology or supplier. 12/

In particular, the Commission sought to insure that transatlantic cables would not be loaded unduly in their early years while readily usable, shorter-lived satellite capacity in which United States investment had already been made lay idle. 13/

The Europeans viewed the guidelines as an unacceptable attempt to administer unilaterally North Atlantic policy. They announced that they would refuse to activate additional North Atlantic circuits until the FCC indicated its willingness to give greater consideration to the positions of foreign administrations in its regulatory process. 14/ The freeze was rescinded shortly after it was announced; however, the FCC then granted applications to use the so-called "TAT-6" cable reflecting the prior agreements of the United States carriers and the European administrations. 15/

A further FCC statement followed calling for the development of a long range, comprehensive plan for the North Atlantic which would delineate specifically construction and utilization of facilities through 1985. 16/ The FCC required the United States carriers to submit extensive information concerning circuit requirements, service reliability and construction costs. The FCC staff used this information to develop a variety of alternative facility plans. The public was invited to comment on the alternatives. The proposals were also discussed at a consultative meeting in Rome.

The FCC then released its Report, Order and Third Statement of Policy and Guidelines which adopted its comprehensive plan. 17/ The plan did not contemplate a seventh transatlantic cable then favored by the European administrations. Strong opposition to the plan was expressed by the United States carriers through petitions for reconsideration and by the European administrations through diplomatic channels. After consultation with the Department of State and the Executive Branch, the plan was modified to include the cable. 18/

A second planning initiative to cover the period 1985-1995 commenced in March 1979 with joint development of general "terms of reference" to guide planning decisions at a Montreal meeting. 19/ Information concerning these "terms of reference" were exchanged at a series of senior level and working group meetings. During this process, the FCC formally initiated a proceeding to consider United States policies and guidelines for the period. In this proceeding the FCC developed initially its own "benchmark plan," just as it developed specific alternatives in its earlier planning initiative. However, in significant contrast to earlier initiative, the FCC did not state a preference for any particular facilities construction and use plan. Instead, it adopted only general policy guidelines designed to encompass a range of acceptable alternatives. 20/

Although the European administrations expressed support for the FCC decision to rely on broad guidelines rather than specific directives, and acknowledged the FCC's efforts to give greater weight to international comity within the limits of its decision-making process, substantive agreement has not been fully achieved.

4. Application of the Policy in the Pacific

The Pacific basin occupies more than one-third of the earth's surface. Yet the region has accounted for a relatively small portion of the world's transborder telecommunications traffic. Traffic between the United States mainland and Pacific points is currently about 10% of total United States transborder traffic. By comparison, Atlantic traffic comprises approximately 70% of total United States transborder flows. 21/ Consequently, the region has been treated as something of a stepchild. United States attention to Pacific telecommunications facility planning has been fleeting and, as in the case of TRANSPAC II, concerned primarily with national security matters. Even in major international forums, the Pacific has taken a back seat. For example, satellites employed in the region by INTELSAT are a generation behind those employed in other regions.

The Pacific transborder telecommunications network consists currently of an INTELSAT IV satellite, TRANSPAC I and II submarine cables reaching Pacific points from Hawaii, three mainland United States -- Hawaii cables, the Compac cable reaching Australia points from Canada via Hawaii and various regional cable systems.

The Pacific basin has experienced recently dramatic traffic increases due primarily to growth in commercial trade and improvements in domestic and regional telecommunications systems. For example, in recent years several Pacific administrations have planned and constructed jointly a number of regional cable systems designed to interconnect island nations and extend the TRANSPAC II system beyond Okinawa. 22/ Prior to the construction of these regional facilities, traffic growth involving many of these points was accommodated by satellite facilities. As a result of this traffic growth critical submarine cable facilities between the mainland United States and between Hawaii and Hawaii and Australia are approaching saturation. Consequently, crucial decisions addressing Pacific facility construction and use will have to be made in the near future.

At the same time, at least two major cable systems are already contemplated by United States carriers and foreign administrations to meet this growing demand. Canada, Australia, the United Kingdom, the Federal Republic of Germany, Fiji, New Zealand, Papua, New Guinea, the Philippines and Hong Kong plan to install the so-called ANZCAN cable. ANZCAN would replace the existing Compac system and would interconnect directly Canada, Hawaii, Fiji, Australia and New Zealand. In addition, it is believed that a very high capacity fiber-optic

facility to interconnect the United States and Japan is contemplated for installation in the latter half of the decade.

There is concern within the FCC that planning for facilities to serve major Pacific points may be fractionalizing. The FCC is concerned that ad hoc consideration of proposals will not yield the lowest cost combination of facilities. Cable proposals will not give appropriate consideration to satellite alternatives and plans for current technology systems will not address future availability of newer technologies. Thus, the FCC has begun a comprehensive review of requirements with an eye toward development of a long range plan. Like the current North Atlantic proceeding, the inquiry is designed to a range of facility alternatives meeting projected traffic demands through year-end 1995. ^{23/}

However, special circumstances applicable to the Pacific will limit the focus of the undertaking.

While planning in the Atlantic attempted to address the selection of both satellite and cable facilities, the choice of satellite design for the Pacific region is determined largely by Atlantic requirements. This is because traffic demand is highest in the Atlantic region and new systems are designed for peak requirements. ^{24/} Historically, the Pacific has been served by satellites with capacity no longer sufficient for continued use in other regions. For example, the Indian Ocean satellite is due to be shifted to the Pacific when the design life of the current Pacific satellite expires in 1982. Therefore, efforts to plan facility construction in the Pacific will be confined primarily to submarine cables. However, the relative use of the technologies will be a focus of the proceeding.

In the initial phase of this inquiry the Commission is limiting its role to compilation and evaluation of data supplied by United States carriers. In the North Atlantic planning process, the Commission participated directly with United States carriers and foreign administrations in developing basic planning data. However, at this stage of the Pacific proceeding, no formal consultations with foreign administrations are planned. The Commission plans to draw upon planning work already undertaken by the United States carriers in consultation with their correspondents.

Participation by United States carriers in the ANZCAN cable will require FCC approval. It is recognized that the ANZCAN cable would alleviate the shortage of cable capacity between Hawaii and Australia. It is also recognized that the cable could alleviate the shortage of capacity between the mainland United States and Hawaii. Thus, international traffic, destined for or originating on the mainland, and domestic Hawaii-mainland traffic could be routed on the Hawaii-Canada segment of the ANZCAN facility and transited to the United States through Canada. Use of the ANZCAN cable in this manner would delay the need for an additional mainland-Hawaii cable. However, there

is some concern that the project could diminish the United States role as the dominant "hubbing" point for Pacific-bound North American and European traffic.

Four alternative facility plans have already been submitted by the United States carriers to the FCC. Plan I assumes that no new cable systems are introduced during the planning period. The plan does not meet projected traffic demand and is, therefore, thought to be unworkable. Plans IIA and IIB assume the introduction of the ANZCAN cable in 1984 with an allocation of 1200 circuits for use by United States carriers to the Canada-Hawaii route only until 1988. According to both plans, a fiber optic cable would be introduced in 1988. Plans IIA and IIB differ in that IIB contemplates use in 1984 of an operational spare satellite as a separate and equal growth route. Foreign operating entities have not agreed to use of the operational spare in this manner. Plan III assumes construction of only the Hawaii-Australia portion of the ANZCAN cable, the introduction of an addition transpacific facility in 1986 and operation of a mainland-Hawaii light-wave facility in 1991.

It is expected that the FCC will issue in January or February 1982 a Notice of Proposed Rulemaking addressing these options. The Notice is expected to establish broad facility guidelines, along the lines of those adopted in the current phase of the North Atlantic inquiry, rather than a single facility plan. Nevertheless, the FCC intends to review critically the proposed alternatives, not merely rubber stamp them. In addition, the FCC may consider limited official contacts with foreign administrations before proposed guidelines are adopted as final policy.

5. Reciprocity and Facility Planning

Application of the concept of reciprocity is finding increasing favor among United States telecommunications policymakers. United States telecommunications policies and those of most other nations diverge, especially with respect to competition.

United States policymakers view with substantial concern perceived efforts by foreign administrations to restrict the competitive opportunities of United States firms. Thus, the Office of the United States Trade Representative has published an inventory of foreign telecommunications trade barriers. ^{25/} The inventory embraces practices and laws designed to limit transborder information flows and services including competitive restrictions on United States data processing services and unfavorable treatment of new international carriers authorized by the FCC.

The Telecommunications Competition and Deregulation Act of 1981, adopted by the United States Senate on July 8, 1981, would create in the FCC "additional" authority to require reciprocity from foreign countries whose telecommunications carriers or firms offering information services

seek access to the United States market. 26/ Some policymakers believe the FCC possesses under existing law authority to require reciprocity in the context of its facility and service licensing procedures.

At a 1979 meeting in Dublin during the North Atlantic consultative process, FCC officials undertook preliminary discussion concerning the Commission's desire to initiate similar consultations concerning foreign attitudes toward new services and new carriers. However, these consultations were said to be for the purpose of explaining and promoting the Commission's policies; the Commission never sought to link directly facility planning and other policy initiatives. 27/

More recently, however, FCC Commissioner Fogarty has called for application of reciprocity for matters of telecommunications trade in the United States facility authorization process. He has stated:

Our pro-competitive policies have opened the U.S. market fully to foreign competition, and in some instances have given that foreign competition an advantage over our own industry Due to trade barriers, there has been no similar penetration of foreign markets by U.S. carriers. Such results, stemming from our ostensibly pro-competitive policies, are ludicrous and must end. 28/

United States carriers currently plan to shoulder two-thirds of the investment in the ANZCAN Canada-Hawaii segment. Commissioner Fogarty suggests that United States participation in foreign facilities such as the ANZCAN cable should be premised on a lowering of the telecommunications trade barriers.

6. Conclusion

While reciprocity is not at this time an established United States practice or policy in the telecommunications field, the potential for its application is apparent. Foreign entities, both government and private, depend upon United States investment in major international facilities and many look to the United States as a major marketplace for their telecommunications goods and services. At the same time, United States policymakers are aware that they cannot meet their stated facility planning goals or advance their competition initiative without the cooperation of foreign administrations and operating entities. Therefore, an understanding of the different status and expectations of United States and foreign participants in the telecommunications planning process must be developed and efforts must be made on both sides to accommodate divergent interests.

In this respect, it is suggested that foreign entities become more directly involved in the FCC

telecommunications planning process through appropriate channels. In the Pacific planning process, foreign entities have relied substantially on the United States carriers for the communication of their views. Without demeaning the role of the United States carriers and their sensitivity to the requirements of their correspondents, they cannot be expected to be sensitive to the full spectrum of foreign policy and trade matters upon which telecommunications planning issues increasingly turn.

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- (19) See, Notice of Proposed Rulemaking, 82 FCC 2d 407 (1980).
- (20) Report and Order, 84 FCC 2d 760 (1981).
- (21) Pacific Region Telecommunications Needs, FCC 81-243, released June 1, 1981.

(22) Recently constructed regional systems include: OKITAI (Okinawa-Taiwan; OLVHO (Luzon-Hong Kong); TAIGU (Taiwan-Guam); TAILU (Taiwan-Luzon); and ASEAN (Phillipines-Singapore-Indonesia-Malaysia-Thailand).

(23) Pacific Region Telecommunications Needs, supra.

(24) "Trade Barriers to Telecommunications, Data and Information Services," Office of the United States Special Trade Representative, February 5, 1981.

(26) S. Report No. 97-170, S. 898, July 27, 1981, p. 53.

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Future Telecommunications Policy for Pacific Island States:

Some Considerations

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1. Abstract

Pacific Island countries need to breakout of the strictures of their traditional telecommunications policies. There is a need for a more conscious effort to provide community-oriented telecommunication services to allow for greater community participation in the processes of national development. International policies need to enhance the abilities of emerging Pacific Island states to join more strongly together and enable greater cooperation between the metropolitan and Island countries of the wide Pacific.

2. INTRODUCTION

The Pacific Basin has been the site of pioneering efforts in the use of telecommunications for community development and international communication. The University of the South Pacific's educational network (USPNET), the PEACESAT system and such national ventures as the Cook Islands H.F. Radio Network have demonstrated, sometimes against strenuous opposition from telecommunication authorities, that it is possible to combine relatively sophisticated satellite communications systems with low-cost ground technology to create the kinds of social networks that bring together the diverse peoples of the Pacific. The systems have been subject to the trial and error of widely varying groups from Pacific Island leaders to Pacific children.

The future of these systems are now in the balance for the time has come when these largely experimental systems can no longer survive without some kind of integration into the mainstream of Pacific telecommunications. Yet the present state of policy ill equips telecommunication authorities to deal with this integration. This is not surprising as our traditional approach to telecommunications has very much reflected our colonial heritages and the state of our knowledge about the processes of development and social change. But we live in revolutionary times. On the national level, just as some Pacific Island countries are experiencing the euphoria of political independence, others are coming out of the heady days of post-colonial freedom to face the harsh realities of unbalanced budgets and rising restlessness and frustration among the common population. Development Plans now show a preoccupation with 'getting the Govern-

ment message across' and political leaders are increasingly concerned with the need to make communities more self-reliant and self-directed in their development efforts. Telecommunications has yet to play the important support role in community development that it is capable of.

3. TELECOMMUNICATIONS AND NATIONAL DEVELOPMENT

Many Pacific Island governments are faced with the problems of modernisation. They are concerned to make united nationals out of traditionally separate communities; they are concerned to provide for the needs of rising populations; they are concerned with the process of integrating traditional cultural patterns with the demands of modern living. But many governments find it difficult to rekindle the spirit of self-reliance amongst their people. One of the important prerequisites to self-reliance is the easy access to centres of assistance. Yet in many Pacific countries the information and expertise that people require in order that they might become more self-reliant is not easily accessible to them. The information and expertise is bound up in government bureaucratic structures and is also restricted by traditional attitudes to authority. However, these are not the only reasons, for many governments are indeed looking for new ways to connect and communicate with the communities that they have a mandate to serve. What is lacking is knowledge of the alternative channels of communication that exist in the present telecommunications networks. And this is also an absence of an appreciation that any process of development requires

that a dialogue or two-way exchange be possible. So it is not only important that we 'get the government message across' it is also important that governments in general and development workers in particular are able to also, listen to and achieve, some understanding of the particular problems faced by communities in their countries. In other words new communication channels and networks need to be established directly between those who have information and expertise and those who need it. So we need telecommunication networks that link directly the field-worker with his agricultural or medical colleagues in the urban supply centres. We also need telecommunication networks that allow for communication between field workers in separated rural locations. In many rural communities the field-worker, the nurse, the teacher are windows to the rest of the world for those communities. They live between the rural world and the urban world and so are often ideally placed to direct the flow of communications and knowledge and assistance between those who can provide and those who most need it. But it is also necessary to give individual rural communities a sense of community with those in similar rural situations. So telecommunications should not only link in a rural to urban pattern; but should also link rural communities together. And if rural economic schemes are to survive then rural entrepreneurs need the telecommunication facilities that are available to, and often taken for granted by, the urban business operators. These are just some obvious applications that governments might consider in future telecommunications policies. But these changes in the allocation and use of telecommunication services also mean a new approach to the administration of the process of development. Government administrations will need to change so that they can process and evaluate more effectively the increase in information being fed back to them through the new channels. So governments will have to focus their attention more sharply upon the processes of communication often taken for granted in their development plans. Telecommunications must therefore be used in the process of development in such a way as to create more effective channels for dialogue and exchange.

4. PUBLIC ACCESS TO POLICY-MAKING ON TELECOMMUNICATIONS

In the Pacific Islands, decisions concerning telecommunications have in the past been the prerogative of technologists and politicians. Yet, this has not been the case for the telecommunications mass media of radio and TV where there often exists policy-making bodies that draw their membership from a wide variety of interest groups in the community. For example, in Fiji the Broadcasting Commission is made up of Government, religious, women and ethnic group representatives. If we consider that the telecommunication services other than those of the electronic mass media are also an important channel for the distribution of information and for the dialogue necessary in the process of development then it is necessary to broaden the base by from which telecommunications policy is made. It is at least necessary that development agencies both inside and outside government should have some input into telecommunications policy. But it is also necessary to involve other interest groups from the wider community. We need the input of agriculturalists, health workers, teachers, community leaders and entrepreneurs. With the inclusion of a wider cross-section of the community in the policy-making process telecommunications services will not only be provided according to political and technological criteria but will also be made according to communication needs of the wider community. And it is perhaps possible that the closer involvement of responsible members of the community may provide the basis for political action to bring about a change in many of the restrictive regulations that now apply in telecommunications. Many of these regulations are inappropriate to the communication needs of developing countries.

5. INTERNATIONAL TELECOMMUNICATIONS: KEEPING OLD ACQUAINTANCES AND MAKING NEW FRIENDS

Pacific Island countries need to find new ways of protecting and representing their interests against the sometimes overwhelming powers on the Pacific Rim. The current exploitation of the resources of the Pacific Ocean can only increase. The extent to which Pacific Island countries will benefit from this exploitation will be influenced by the degree to which the smaller countries of the Pacific Ocean can join together. It is important then that telecommunications networks exist between the countries of the Pacific to help bind them more strongly together. There is a need to establish a Pacific Island community that includes countries of the 'British', 'French' and 'American' Pacific. International telecommunications policy must therefore enable the communities of these countries to share information, knowledge and expertise in the way that the University of the South Pacific and PEACESAT networks have allowed. It is important that telecommunications policy does not divide peoples of common heritage but allow them to strengthen ties. The probable establishment of PEACESAT-type networks in Micronesia and in the University of the South Pacific region operating through established commercial networks is indeed a positive first step in the development of appropriate community-oriented international telecommunications. In the future consideration will also have to be given to the possibility of creating greater connections between networks and across regions of the Pacific.

Inter-island communication networks are but one aspect of the development of appropriate international telecommunications. The Pacific Island countries not only need to communicate with each other but they also require the ability to communicate with their metropolitan neighbours. The ability to communicate readily is necessary because many Pacific Island countries are significantly dependent upon these neighbours for trade and expertise and security. The relationships are not always smooth because of the often great imbalances that exist between the countries in such matters as trade. So the need for readily accessible communications is an important ingredient in the delicate balancing act that needs to be undertaken to enhance

the relationships between the Island states and the metropolitan countries of the Pacific. Telecommunications can provide some of the avenues necessary for greater international cooperation and the development of the Australian Domestic satellite system is a potential area for such cooperation in telecommunications.

6. CONCLUSION

Telecommunications policies for the future should concentrate on the provision of services that build bridges between communities. Therefore, national policy needs to be reconsidered in terms of community needs and the process of development within the island nations of the Pacific. An emphasis should be placed on the creation of services that give rural communities access to the information and expertise that will enable them to attain greater self-reliance. International policies should allow for the development of stronger relationships among the newly emerging Pacific Island countries and greater cooperation between these island states and their metropolitan neighbours.

POLICY IMPLICATIONS OF
FUTURE TELECOMMUNICATIONS SERVICES

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In thinking about what to say on this panel, my initial task was to decide which future services I should discuss. My first list included direct television broadcasting by satellite (DBS), video teleconferencing, interactive cable TV, videotext, teletex, electronic funds transfer, packet switched data services, and other marvels brought about by the confluence of bounding technological advances in computers, telecommunications and satellites.

However, upon reflection, I have decided not to discuss the policy implications of specific future telecommunications services. The problem I had was in arriving at a definition for "future" that would have uniform meaning to the participants in this conference. The difficulty stems from the fact that one nation's "future" is often another nation's "old hat." Several examples are: Videotext services are "future" in the United States and most of the world but "old hat" in the United Kingdom; broadcast television is "future" in Fiji but "old hat" in most of the world; direct international satellite services are "future" in Papua-New Guinea but "old hat" in Tonga; telephones are "future" for the rural poor but "old hat" for most of the world; and packet switched services are common in the United States but future in most of the world. Each of you could probably create a better and more confounding list.

Since I do not intend to discuss the policy implications of each "future" service, one by one, I would like to review the common problems that confront policy makers in all nations caused by the introduction of new telecommunications services. I believe that policy makers--or influencers--in every nation, when considering the policy implications of a future telecommunications service, will have similar common concerns, the range of which will depend upon the specific service under consideration. However, before I make a few observations on how common concerns for the same "future" service yield different results on a national basis, I would like to point out the range of policy implications that will be considered in the provision of any "future" telecommunications services. Implicit in these general policy implications is the understanding that there is a demand for a "future" service and it is feasible and affordable.

In the larger perspective, it is increasingly difficult, if not impossible, to create national telecommunications policies without consideration of international implications, be they technical, operational, political or economic. The "global village" on which we are spinning through space is quite small and intimately interconnected in the telecommunications field. Because of this reality, policy makers have to weigh the advantages of free

flow and access to information against the concerns of personal privacy, and economic and cultural protectionism.

On a national level, choices will have to be made as to whether future services will be provided by designated monopolies or in a competitive environment. The economic and social values of a specific future telecommunications service, alternatively to individuals as users versus the nation as a whole, will influence pricing strategies. The rate of growth of the technology underlying a future telecommunication service and the cost of implementing it will be an important factor in the timing of the introduction of the service.

Policy makers in some nations have been concerned about the impact of new telecommunication services on existing cultural values. However, cultural "intrusion" is not new; it has been a fact of life through the ages. Cultures develop by a process of accretion and adaptation; what is new is the speed and penetration into cultures made possible by the telecommunications technology of today and tomorrow.

The policy implications of direct television broadcast by satellite, or DBS as it has come to be known, is a "future" service I would like to use as an illustration of how different nations may treat the same service. However, it should be first noted that, on a limited basis, DBS service already exists on a "community" level in a few nations, e.g. the U.S.S.R., Canada and the United States. In the U.S.S.R., it was a conscious national decision to provide the service, but in Canada and the United States the public converted a common carrier TV distribution service into DBS.

The development of DBS service on an individual reception basis is underway in several countries. In most cases, a deliberate policy determination was made on the national level to construct the requisite facilities and provide the service. In the United States, the policy makers are still catching up to large number of private sector requests to provide DBS service. In respect to the policy concerns noted above, all the existing programs have carefully considered the international implications of their national DBS service. In the United States, the Federal Communications Commission has made it clear that any facilities authorization will be subject to the results of an upcoming regional ITU conference. The other national programs appear to conform to the requirements for ITU Regions 1 and 3 set forth

in the 1977 Broadcasting WARC.

It appears that the United States has opted for a competitive economic climate for DBS, while the others appear to be national monopolies. Policy determinations regarding free flow of information will undoubtedly be controlled by widely differing national laws. The U.N. Outer Space Committee has for some years been discussing principles governing international DBS service, which will obviously not apply to national service.

How DBS service will be paid for in each of the national programs is not yet quite clear, except in the United States. The U.S. DBS subscriber will either pay the program provider directly, or indirectly through the cost of advertising. The cultural and economic aspects of "spillover" DBS is one of the most perplexing problems before us in the policy field.

In addition to the national policy level discussed above, I would like to point out that there are international telecommunications organizations that must consider the implications of future services. Obviously the International Telecommunications Union and its predecessors have been doing this for over one hundred years. However, two much newer organizations, INTELSAT and INMARSAT, should have on their agendas the policy implications of future telecommunications services. I personally see some need for attention in this area.

In summary, we are in the midst of an "information" age which is coupled to the past by powerful institutions and traditions created to serve another age. The forcing function of rapid technological growth challenges policy makers to either change or adapt these outmoded institutions and traditions in order to achieve the promise of future telecommunications services.

SOCIAL AND POLICY IMPLICATIONS OF INTRODUCING NEW SERVICES IN A DEVELOPING COUNTRY

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1. ABSTRACT

The people of a developing country have a different set of telecommunication requirements than those in the more advanced nations. There also exist various competing sectors for the limited investible funds available. These, including other factors such as cultural diversity and urban-rural inequities should figure prominently in formulating policies on new service introduction.

2. NEW TELECOMMUNICATION SERVICES

The rapid technological development in the field of telecommunication and computer generates a great deal of interest and expectations to their possible applications, advantages and benefits to the society as a whole. Aside from the rapid development in the telephony, telex and television, rapid transfer of information through facsimile, videotex, teletex, videophone, teleconferencing, telemedicine, electronic fund transfer, electronic mail, electronic system for shopping and voting are being introduced to the public.

Some of the foreseen advantages and changing pattern of living are in the following:

- 2.1 Improvement of Education by making it available to all classes of the society.
- 2.2 Improvement of Medical care.
- 2.3 Access to Data Bank.
- 2.4 As a substitute for transportation, some office workers may work at home thru a terminal. In addition, electronic system for shopping, banking, conferences, mail and voting will save a lot of time and travel.
- 2.5 Dispersal of business and industry.
- 2.6 Improved citizen-government interaction.

3. REQUIREMENTS OF DEVELOPING COUNTRIES

Communication services arise in response to human needs. Although these needs are generically the same, their configuration and depth vary from one country to another in as much as the imperatives generated by the socio-economic milieu of countries are different and dynamic. To a developing country which is technologically "impoverished", this brings forth the problem of selecting and adopting the appropriate and feasible communications services which emerged out of the particular needs of the industrialized world.

Briefly, a developing country is characterized by the following:

- 3.1 Low level of income. Countries with income (GNP) per capita of \$1,000 annually are ordinarily designated as developing.
- 3.2 Scarcity of capital. Low level of income inhibits capital accumulation giving rise to the vicious circle of poverty. This necessitates prioritization of investment alternatives and society, therefore, can only satisfy its wants to a limited extent.
- 3.3 Rapid population growth, low literacy and short life expectancy. To the extent that rapid population growth gives rise to sizeable expenditure in social services at the expense of capital goods, economic development is hindered. Whatever economic gain is achieved is negated by the need to spread such gain among a greater number of people.
- 3.4 Regional income disparity. This brings forth urban in-migration and breeds congestion, unemployment and social unrest within the cities.
- 3.5 Low telephone density. Delivery of new telecommunication services will be dependent on the availability of telephone facilities in the country.

By advanced countries' standard, new services represent the highest levels in the hierarchy of needs. To a developing country still struggling to meet basic needs, such services are frivolous.

By Third World standard, new telecommunication services would refer to less "exotic" services that cater to the basic imperatives. Primarily because of economic constraints, the more sophisticated telecommunications features which emerged from the technological explosion are apt to find limited application even in the urban areas. For the rural people, new services would refer to those addressed towards social improvement such

as communications for health care, education, and for government administrative purposes. They would also refer to the fundamental telecommunications services such as plain old telephone service which up to now are judged to be relatively insufficient even in the urban centers.

4. POLICY ISSUES ON NEW SERVICES

Choice of communication services and formulation of communication policies suitable for a developing country should be in accordance with the specific needs of that country. These needs are defined by the compelling objective of the Third-World-sustained economic growth and changes in social attitudes and customs which have in the past impeded economic advances. Such policies should, however, be tempered with pragmatism in the light of various constraints facing the country.

In particular, among the social and economic issues on new service introduction are the following:

- 4.1 The telecommunications sector competes with other sectors for its share of a country's limited investible resources. Wherever there is scarcity of capital, an abundance of manpower resources, and where basic needs are hardly met, labor absorbing and high capital yielding industries always get first preferences. Those directed at social upliftment such as housing and education also assume prominent places in the investment hierarchy. Despite its leading role in the development process, the impact of telecommunications is felt only when complementary infrastructures like roads and electricity are in existence requiring, therefore, parallel investment undertaking in these other sectors. Thus, investment allocation for telecommunications can only be moderate and whatever funds are made available to telecommunications do not stretch very far since it is highly capital intensive.
- 4.2 Sometime capital can be made available from internally generated funds. However, a second constraint faces telecommunications investment and this is sourced in the high import content of most telecommunications investment. Even while the telecom administration has shown itself capable of financing a huge expansion program, the monetary authority, in its task of managing the balance of payment of the country, scales this down once it sees the foreign exchange resources this would entail.
- 4.3 New services in the urban cores are normally set back by the high investment required and that they generally cater to a small elite group. Usually, revenue derived is

also not compensatory to cost especially at the early stages of service introduction where economy of scale has not been reached. Since basic telephone service is still inadequate at these areas, the choice is one of whether to provide limited specialized services to a small elite group or a greater number of telephone lines to the bigger base of common people. The case for new services is further eroded when revenue fails to match cost since this would mean that the elite group is subsidized by the masses.

- 4.4 Nature of new services is such that although they are different in design, philosophies and technological aspects as these evolved out of the peculiarities of the countries they were developed, they essentially serve the same purpose from the end user's viewpoint. For a developing country which cannot afford the luxury of having a variety of substitute services but which also does not have the experience to select the most suitable ones, the decision is an extremely difficult one to make.
- 4.5 In the rural areas, a critical conditioning factor in telecommunications development is the diversity in cultural backgrounds of the population. For instance, it is common to find people living in various portions of the country to speak different dialects. To some, the national language is unknown. As the national language is usually rooted on a certain dialect, it symbolizes the dominant position of one segment of the population over the rest from the viewpoint of a few others. A nationally integrated educational TV and broadcast network may be ineffective initially due to language and cultural differences of the various regions. While telecommunications for health care is very relevant due to a low ratio of medical practitioner to population, service should also consider the diversity in social values and beliefs as it affects acceptance of providing modern health care.
- 4.6 In so far as basic service in the rural areas is concerned, an issue is whether to cover a wide geographical area but extending limited service to each community or to extend a slightly wider spectrum of services but only to a few areas. While an extensive network is more egalitarian and socially more appealing, practical consideration favors attending initial service provision to a community while incremental cost in expanding such service is minimal. Experience in the Philippines shows that by upgrading the public toll station for a community to a rural telephone exchange, total investment only doubles but revenue increases several folds due to better coverage, thereby reducing the subsidy

required by the community. Besides, the economic development of the area is faster with a local exchange than with a toll station.

- 4.7 On a more general plane, telecommunication policies should also address themselves to urban-rural inequities and needs. Basic telephone service in the rural areas is important but business and industry in the cities also have their requirements particularly for international services. It is the task of the development planner to effect a judicious allocation of resources. However, for the rural areas, new services as defined within the context of the urban population, should only come once the fundamental services have been made available.

5. SUMMARY

No doubt, new service introduction in a developing country is an important ingredient in accelerating the social and economic development of a country. However, it is also fraught with problems and constraints.

In summary, some policy considerations in extending new services in a developing country are the following:

- 5.1 A developing country can only set modest targets in new service provision. Enormous capital requirement, need for equivalent development in other infrastructures, and inadequacy of even the basic telephone service dictate such moderation. Selectivity in choice of service is likewise called for.
- 5.2 New service provision should be integrated with the overall telecommunications development plan of the country. This would optimize investment, avoid costly duplication, and protect them from being rendered obsolete by the rapid technological change.
- 5.3 Telecommunications plan especially that portion on socially-oriented telecommunications should in turn be developed in coordination with the requirements and plans of ministries and agencies directed at social services. Telecommunications serves as a substitute means in extending social services and budgetary allocation should take this into account.
- 5.4 In the urban areas, the few or the "elite" requiring sophisticated new services should be asked to at least partially finance their provision. To the extent possible, revenue should be such that cost of service is adequately covered.
- 5.5 In the rural areas, communication interaction of the rural folks should be expanded gradually to avoid "culture shock". Social telecommunications may also proved to be more effective if they are regional in orientation. Practical consideration further favors relatively intensive service provision to a few areas rather the "shotgun" approach of offering limited service but to a wide geographical sphere.
- 5.6 Between sophisticated services for the urban elite and fundamental service for the rural masses, some degree of preference should be extended to the latter.
- 5.7 Developing countries should also utilize regional telecommunication communities as forums for disseminating and acquiring information on new products and services and on their applicability and implication on a Third World country. Such sharing of information is a logical possibility in the light of lack of trained planners and engineers in developing countries.